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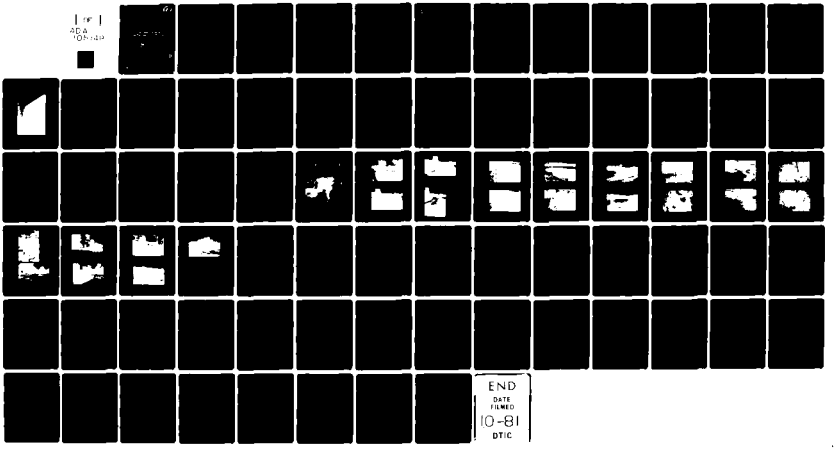

LEVEL II

MISSOURI-NEMAHA-NODAWAY BASIN

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USSARY DAM

BUCHANAN COUNTY, MISSOURI

MO. 10698

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PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM.

Ussary Dam (MO 10698).
Missouri - Nemaha - Nodaway Basin,
Buchanan County, Missouri. Phase I Inspection Report.

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PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

JUNE, 1980

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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USSARY DAM
BUCHANAN COUNTY, MISSOURI
MISSOURI INVENTORY NO. MO 10698

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

UNDER DIRECTION OF

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

JUNE, 1980

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: Ussary Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Ussary Dam (MO 10698).

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

a. Spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.

b. Overtopping of the dam could result in failure of the dam.

c. Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED — 17 SEP 1980
Chief, Engineering Division — Date

APPROVED BY: SIGNED — 18 SEP 1980
Colonel, CE, District Engineer — Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Name of Dam	Ussary Dam
State Located	Missouri
County Located	Buchanan County
Stream	Possum Hollow Creek
Date of Inspection	June 2, 1980

Ussary Dam was inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderegger, Inc. The purpose of the inspection was to make an assessment of the general conditions of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers.

Ussary Dam has a height of thirty-seven (37) feet and a storage capacity at the minimum top elevation of the dam of sixty-three (63) acre-feet. In accordance with the guidelines, a small size dam has a height greater than or equal to twenty-five (25) feet but less than forty (40) feet and a storage capacity greater than or equal to fifty (50) acre-feet but less than one thousand (1,000) acre-feet. The size classification is determined by either the storage capacity or height, whichever gives the larger size category. Ussary Dam is classified as a small size dam.

In accordance with the guidelines and based on visual observation, the dam is classified as having a high potential for damage and loss of life. Failure would threaten life and property. The estimated damage zone extends approximately two (2) miles downstream of the dam. Within the damage zone are several house trailers, at least twelve houses in the town of Agency and Highway H.

Our inspection and evaluation indicates that the spillways do not meet the criteria set forth in the recommended guidelines for a small dam having a high hazard potential. Considering the small volume of water impounded and the downstream channel from the dam, one half of the Probable Maximum Flood is the appropriate spillway design flood. The spillways will not pass the 100-year flood (1% probability flood - a flood having a one percent chance of being exceeded in any one year) without overtopping the dam. The spillways will pass 13% of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Design data were not available for this dam. Based on the observations made during the field inspection of the dam, the following remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams:

a. Alternatives.

(1) The spillway size and/or the height of dam should be increased to pass 50 percent of the probable maximum flood without overtopping the dam. Spillway design should include erosion controls in order to prevent the headcutting that is occurring in the existing emergency spillway.

b. Operation and Maintenance Procedures.

(1) Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" should be performed. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter or record.

(2) The existing small head cut at the outlet end of the emergency spillway should be stabilized in order to minimize future problems that will result from deep head cutting if the erosion is not controlled.

(3) The slump area at the downstream toe of the dam should be repaired. Excavation of the slump area and backfilling with well-graded road gravel should stabilize this area.

(4) The amount and clarity of seepage along the downstream toe of the dam should be monitored regularly, particularly during periods of high reservoir levels. Records of these inspections should be made a part of this project file.

(5) Measures should be taken to assure that the inlet of the principal spillway is clear of trash and debris.

(6) A program of regular inspection of the dam, with particular attention to monitoring the downstream seep and slump area and the results of stabilizing the head cut in the earth spillway outlet, should be initiated. Records of these inspections should be made a part of this project file.

Rey S. Decker
E-3703

Gordon Jamison

Garold Ulmer
E-19246

H. P. Hoskins

Harold P. Hoskins, Chairman of the Board
Hoskins-Western-Sonderegger, Inc.
E-8696

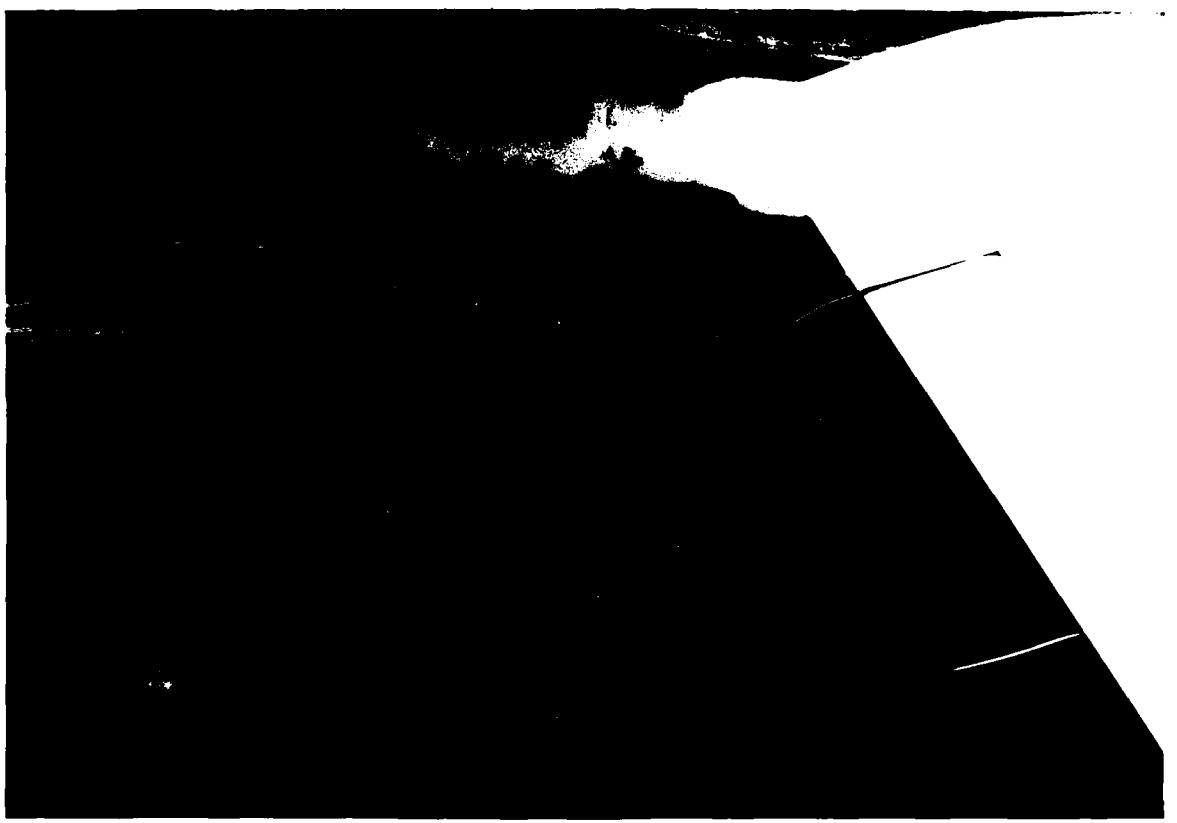


PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
USSARY DAM - MO 10698
BUCHANAN COUNTY, MISSOURI

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Ussary Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams, "Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams," dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earth fill approximately 290 feet in length and 37 feet high. The maximum water storage at the minimum top elevation of the dam is 63 acre-feet. It is located near the center of Buchanan County about 6 miles south of St. Joseph, Missouri.

(2) The uncontrolled principal spillway consists of a 54-inch diameter corrugated metal pipe (CMP) drop inlet (riser) five feet high. The riser is connected to a 36-inch CMP conduit through the dam. The spillway is located near the right end of the dam.

(3) A vegetated earth emergency spillway is located on the left abutment.

(4) Pertinent physical data are given in paragraph 1.3 below.

b. Location. The dam is located on Possum Hollow Creek near the center of Buchanan County about 1.3 miles west of Agency, Missouri in the SW 1/4 of Sec. 30, T56N, R34W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. The dam has a height of 37 feet and a storage capacity of 63 acre-feet. This dam is classified as a small size dam. A small size dam has a height greater than or equal to 25 feet but less than 40 feet and a storage capacity greater than or equal to 50 acre-feet but less than 1,000 acre-feet. The size classification is determined by either the storage or height, whichever gives the larger size category.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph 1.1c above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends about two miles downstream of the dam. Visual observation verifies that within the damage zone are several house trailers, at least twelve houses in the town of Agency and Highway H.

e. Ownership. The dam is owned by Mr. & Mrs. John Ussary, Rt. 1, Agency, Missouri 64401.

f. Purpose of Dam. The dam was constructed primarily for erosion and gully control. It also provides flood control.

g. Design and Construction History. No design information was available. The dam was constructed by Mr. Ussary in 1969.

h. Normal Operating Procedure. There are no controlled outlets for this dam. The level of the pool is dependent upon precipitation, runoff, and the capacity of the spillways.

1.3 PERTINENT DATA

a. Drainage Area. 363.7 acres (0.568 square miles).

b. Discharge at Damsite.

(1) All discharges at the damsite are through an uncontrolled principal spillway (54" CMP riser and 36" CMP conduit) and an uncontrolled earthen channel type emergency spillway.

(2) Estimated maximum flood at damsite -- Mr. Ussary stated that approximately two years after the dam was built water flowed about a foot and a half deep in the emergency spillway following 14 inches of rain.

(3) The principal spillway capacity varies from 0 c.f.s. at elevation 895.0 feet to 98 c.f.s. at the crest of the emergency spillway (elevation 896.7 feet) to 147 c.f.s. at the minimum top of dam (elevation 898.7 feet).

(4) The emergency spillway capacity varies from 0 c.f.s. at its crest elevation 896.7 feet to 370 c.f.s. at elevation 898.7 feet (minimum top of dam).

(5) Total spillway capacity at the minimum top of dam is 480 c.f.s. ±.

c. Elevation (feet above M.S.L.).

(1) Observed pool - 895

(2) Normal pool - 895

(3) Spillway crest (s).

Principal - 895

Emergency - 896.7

(4) Maximum experienced pool - 898 ±.

(5) Top of dam (minimum) - 898.7

d. Reservoir. Length (feet) of pool

(1) At principal spillway crest - 900 ±

(2) At emergency spillway crest - 1300 ±

(3) At top of dam (minimum) - 1700 ±

e. Storage (Acre-feet).

(1) Observed pool - 39 ±

(2) Normal pool - 39 ±

(3) Spillway crests.

Principal - 39 ±

Emergency - 48 ±

(4) Maximum experienced pool - 57 ±

(5) Top of dam (minimum) - 63 ±

f. Reservoir Surface (Acres).

(1) Observed pool - 4.6 ±

(2) Normal pool - 4.6 ±

(3) Spillway crests.

Principal - 4.6 ±

Emergency - 5.8 ±

(4) Maximum experienced pool - 7.0 ±

(5) Top of dam (minimum) - 8.0 ±

g. Dam.

(1) Type - Homogeneous earth fill

(2) Length - 290 ft. ±

(3) Height - 37 ft. ±

(4) Top width - 13 ft. ±

(5) Side slopes.

(a) Downstream - 1V on 2.3H (measured)

(b) Upstream - 1V on 3H (measured)

(6) Zoning - None

(7) Impervious core - None

(8) Cutoff - Unknown

(9) Grout curtain - None

(10) Wave protection - None

(11) Drains - None

h. Diversion Channel and Regulating Tunnel. None

i. Spillway.

(1) Principal

(a) Type - Uncontrolled, 54-inch diameter CMP riser 5 feet in depth with a 36-inch diameter CMP conduit passing through the embankment at station 2 + 92.

(b) Crest (invert) elevation - 895.0 (M.S.L.)

Outlet - 863.5 (M.S.L.)

(c) Length - 114 ft. ±

(2) Emergency

(a) Type - Uncontrolled, vegetated earth, spillway through the left abutment. It has a parabolic cross section with a top width of about 80 feet.

(b) Control section - vegetated earth, sharp weir-like crest about 30 ft. upstream from the centerline of the dam.

(c) Crest elevation - 896.7 (M.S.L.)

(d) Upstream Channel - vegetated earth and open

(e) Downstream Channel - vegetated earth about 150 ft. long on overall slope of about 4%.

j. Regulating Outlets. None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam.

2.2 CONSTRUCTION

No construction data were available. It was reported by Mr. Ussary that he constructed the dam in 1969.

2.3 OPERATION

No data were available on spillway operation. It was reported by Mr. Ussary that the maximum flow through the emergency spillway was about 1.5 feet after a 14-inch rain about 2 years after the dam was constructed.

2.4 EVALUATION

a. Availability. No data were available.

b. Adequacy. The field surveys and visual observation presented herein are considered adequate to support the conclusions of this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Ussary Dam was made on June 2, 1980. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska making the inspection were: R. S. Decker, Geotechnical; Garold Ulmer and Gordon Jamison, Hydrology & Hydraulics. Mr. and Mrs. Ussary accompanied the inspection team.

b. Dam.

(1) Geology and Soils (abutment and embankment). This dam is located in the dissected till plains physiographic area in the rough hill land of the loessial bluffs bordering the Missouri River. Upland soils consist of moderately deep loess over glacial till. The abutments consist of 5 to 15 feet of loess (CL) overlying 3-5 feet of CL-CH glacial till which overlies shale bedrock which is exposed in the channel and in the right abutment. The shale bedrock belongs to the Kansas City Group, Missoanan Series, Pennsylvanian System. Materials in the valley bottom consist of 4-5 feet of loessial alluvium overlying shale. Materials in the embankment consist of CL loess borrowed from the reservoir area and the abutments.

(2) Upstream Slope. The upstream slope is well vegetated. No significant erosion was observed. No cracks, slumps or deformations were observed. Photo No. 3 shows the upstream slope.

(3) Crest. The crest is rutted by vehicular traffic and is sparsely vegetated. No cracks or slumps were observed. Measurements along the crest show that it is low on the left end and slopes upward to the right abutment with about 4.6 feet difference in elevation from left end to right end. The crest line profile is shown on Plate C-1. Photo No. 4 shows the crest, and Photo No. 5 shows the crest looking over the emergency spillway in the foreground.

(4) Downstream Slope. The downstream slope is well vegetated with adapted grasses. No cracks, rodent holes, or deformations were observed on the slope. The downstream slope is shown in Photos 6 & 7. A small seep (discharge too small to estimate) and a slump area was observed on the left side of the outlet of the principal spillway about 8 feet above and 20 feet upslope from the outlet end of the pipe. This slump area is shown in Photo No. 17. Seepage also discharges from the shale exposed on both sides of the principal spillway scour hole shown in Photos 14 and 15. All seepage is clear,

and total discharge was estimated at less than 0.5 g.p.m. A gully is eroded down to shale in the lower end of the right abutment trough, outletting into the stilling basin near the right side of the spillway pipe. This gully extends up to about elevation 875. No seepage was observed in the shale exposed in the gully. Photo No. 18 shows the shale in the gully.

c. Appurtenant Structures.

(1) The principal spillway is uncontrolled and consists of a 54-inch CMP riser with 36-inch CMP conduit passing through the dam on an angle of about 30°. The pipe appears to be in good condition at the inlet and outlet. The inlet of the riser is partially blocked with logs and trash. Photo No. 13 shows the inlet of the principal spillway. The outlet is shown in Photo No. 15. The scour hole at the outlet is cut into shale and appears to be stable. Flow through the spillway was estimated at 1-2 c.f.s. (the site was revisited on July 3 and the inlet was clear).

(2) The emergency spillway is uncontrolled and is cut through the left abutment. The approach section is sparsely vegetated as shown in Photo No. 8. The out'et channel is well vegetated as shown in Photo No. 9. A small gully is head cutting into the exit channel about 200 feet downstream from the centerline of the dam. This is shown in Photo No. 16. No other erosion or slumps were observed in the spillway. The roadway and field adjoining the left side of the spillway are lower than the minimum crest of the dam and will serve as a supplemental or secondary emergency spillway.

(3) Drawdown facilities. There are no drawdown facilities for this dam.

d. Reservoir Area. No significant erosion was observed around the shoreline. Photos 10 and 11 show portions of the reservoir.

e. Downstream Channel. The downstream channel is clear and stable. Photo No. 12 shows the downstream channel and scour hole of the principal spillway.

3.2 EVALUATION

This structure is generally in good condition and does not appear to have any serious deficiencies. The seep and slump area left and slightly upstream from the pipe outlet should be monitored and probably stabilized with a few loads of gravel. The gully in the right abutment trough is cut into shale and should be pretty well stabilized Measures should be taken to keep the inlet to the principal spillway clear. The head cut at the end of the emergency spillway is not serious at the present time but could develop into a serious problem.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam. The pool level is controlled by rainfall, infiltration, evaporation, and the capacity of the uncontrolled spillways.

4.2 MAINTENANCE OF DAM

Maintenance of this structure appears to be reasonably good. The principal spillway inlet should be cleared and measures taken to keep it clear. Minor stabilization repair work at the end of the emergency spillway and in the small slump at the toe of the dam should be carried out.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

The deficiencies observed during the inspection can be corrected by an improvement in maintenance.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No design data were found for this dam.

b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were developed from the USGS St. Joseph South, MO. - Kans. 7 1/2 minute topographic quadrangle map. The hydraulic computations for the spillway and dam overtopping discharge ratings were based on data collected in the field at the time of the field inspection

c. Visual Observations.

(1) The crest of the principal spillway riser is only about 50% effective (see Photo No. 13) for low flows due to debris caught on the crest (logs and heavy moss). The riser crest should be cleaned immediately and an effort made to keep it clean. If left as is it could render the spillway ineffective for flood flows. It should be noted that the site was visited again on July 3, 1980 and the crest was completely clear.

(2) The emergency spillway crest is only in fair condition due to the light stand of grass. The head cutting at the downstream end of the spillway should be watched.

(3) The dam crest profile (see Plate C-1) indicates that the county road on the left side of the emergency spillway will overtop before the dam will. The road will then act as part of the emergency spillway, thus relieving some pressure from the dam.

d. Overtopping Potential. The spillways are too small to pass 50% of the probable maximum flood without overtopping. The spillways are also too small to pass the 1% probability flood without overtopping. The spillways will pass 13% of the probable maximum flood without overtopping the dam. Overtopping is dangerous because the flow of water over the crest will erode the face of the dam and, if continued long enough, will breach the dam with sudden release of all of the impounded water into the downstream floodplain.

The results of the routings through the dam are tabulated in regards to the following conditions:

Frequency	Inflow Discharge c.f.s.	Outflow Discharge c.f.s.	Maximum Pool Elevation	*Maximum Depth Over Dam Feet	Duration Over Top Hours
1/2 PMF	2460	2280	900.0	2.2	16
PMF	4920	4850	902.1	3.4	16
0.13 PMF	650	480	898.7	0	--

*Minimum top of dam elevation - 898.7

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a High hazard rating and a Small size. Therefore, the 1/2 PMF to PMF is the test of the adequacy of the dam and its spillway.

The estimated damage zone is described in Paragraph 1.2d in this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation. The dam appears to be structurally stable at the present time. The small slump at the downstream toe just left of the spillway pipe appears to be stable. This slump and seep could have been caused by excessive uplift pressure under full reservoir heads reported to have occurred a couple of years after the dam was built and prior to the establishment of drainage through the shale bedrock into the scour hole. The measured slopes of 1V on 3H up and 2.3H down should provide adequate safety against major shear failures now that temporary uplift (seepage) pressures at the toe appear to have been relieved by drainage into the scour hole. Uncontrolled head cutting at the end of the emergency spillway could ultimately breach the reservoir but should not affect the integrity of the dam. Overtopping of this dam should be avoided because the flow of water over the crest will erode the face of the dam and, if continued long enough, will breach the dam with sudden release of all of the impounded water into the downstream floodplain.

b. Design and Construction Data. No design or construction data were available. Seepage and stability analysis comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Operating Records. There are no controlled operating facilities for this dam.

d. Post Construction Changes. None, according to the Owner.

e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of the magnitude predicted in this area is not expected to cause structural failure of this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. This dam is in good structural condition and does not appear to have a serious potential of structural failure. The deficiencies observed during the inspection do not appear to be serious at the present time but do warrant attention in the near future in order to forestall continuing deterioration. Conditions needing maintenance and repair are included in paragraph 7.2b. According to the approximate analyses performed for this dam, the spillway capacity is seriously inadequate. The spillways will not pass the 1 percent probability flood without overtopping the dam. 50 percent of the probable maximum flood, which is the recommended spillway design flood, will overtop the dam by 2.2 feet for a period of 16 hours. Overtopping is dangerous because the flow of water over the crest will erode the face of the dam and, if continued long enough, will breach the dam with sudden release of all of the impounded water into the downstream floodplain.

b. Adequacy of Information. Due to the lack of engineering data, the conclusions in this report are based upon performance history and visual observations. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. A program should be developed as soon as possible to monitor at regular intervals the deficiencies described in this report. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. The item recommended in paragraph 7.2a should be pursued on a high priority basis.

d. Necessity for Further Investigations. The additional studies and analyses recommended in paragraph 7.2b should be accomplished by the owner in the near future.

e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of this magnitude is not expected to be hazardous to this dam. It is recommended, however, that the prescribed seismic loading for Seismic Zone 1 be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a registered professional engineer experienced in the design and construction of earth dams.

a. Alternatives.

(1) The spillway size and/or the height of dam should be increased to pass 50 percent of the probable maximum flood without overtopping the dam. Spillway design should include erosion controls in order to prevent the headcutting that is occurring in the existing emergency spillway.

b. Operation and Maintenance Procedures.

(1) Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" should be performed. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

(2) The existing small head cut at the outlet end of the emergency spillway should be stabilized in order to minimize future problems that will result from deep head cutting if the erosion is not controlled.

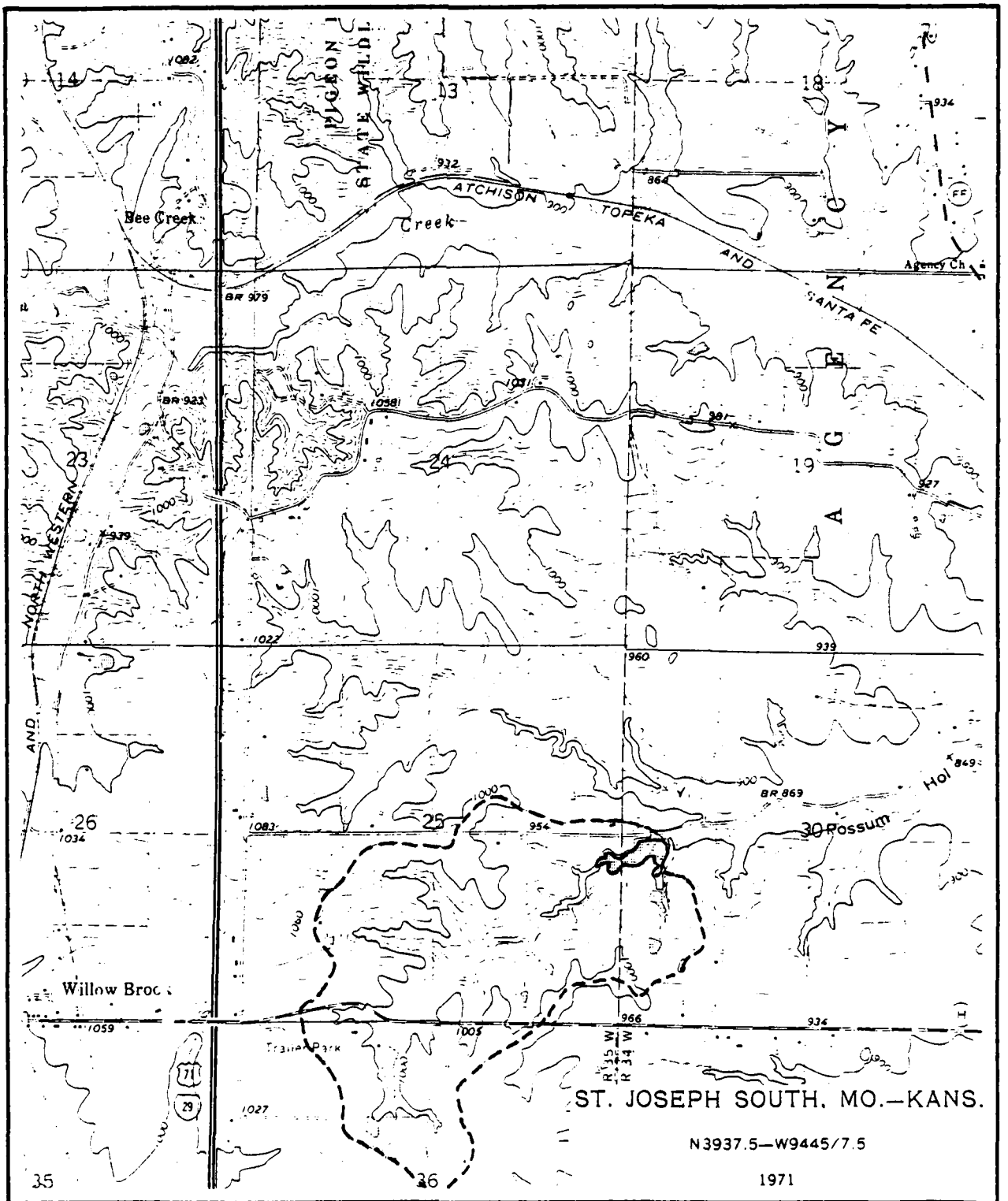
(3) The slump area at the downstream toe of the dam should be repaired. Excavation of the slump area and backfilling with well-graded road gravel should stabilize this area.

(4) The amount and clarity of seepage along the downstream toe of the dam should be monitored regularly, particularly during periods of high reservoir levels. Records of these inspections should be made a part of this project file.

(5) Measures should be taken to assure that the inlet of the principal spillway is clear of trash and debris.

(6) A program of regular inspection of the dam, with particular attention to monitoring the downstream seep and slump area and the results of stabilizing the head cut in the earth spillway outlet, should be initiated. Records of these inspections should be made a part of this project file.

APPENDIX A
MAPS



Scale in feet

2000 1000 0 2000 4000

Contour Interval – 20'

N

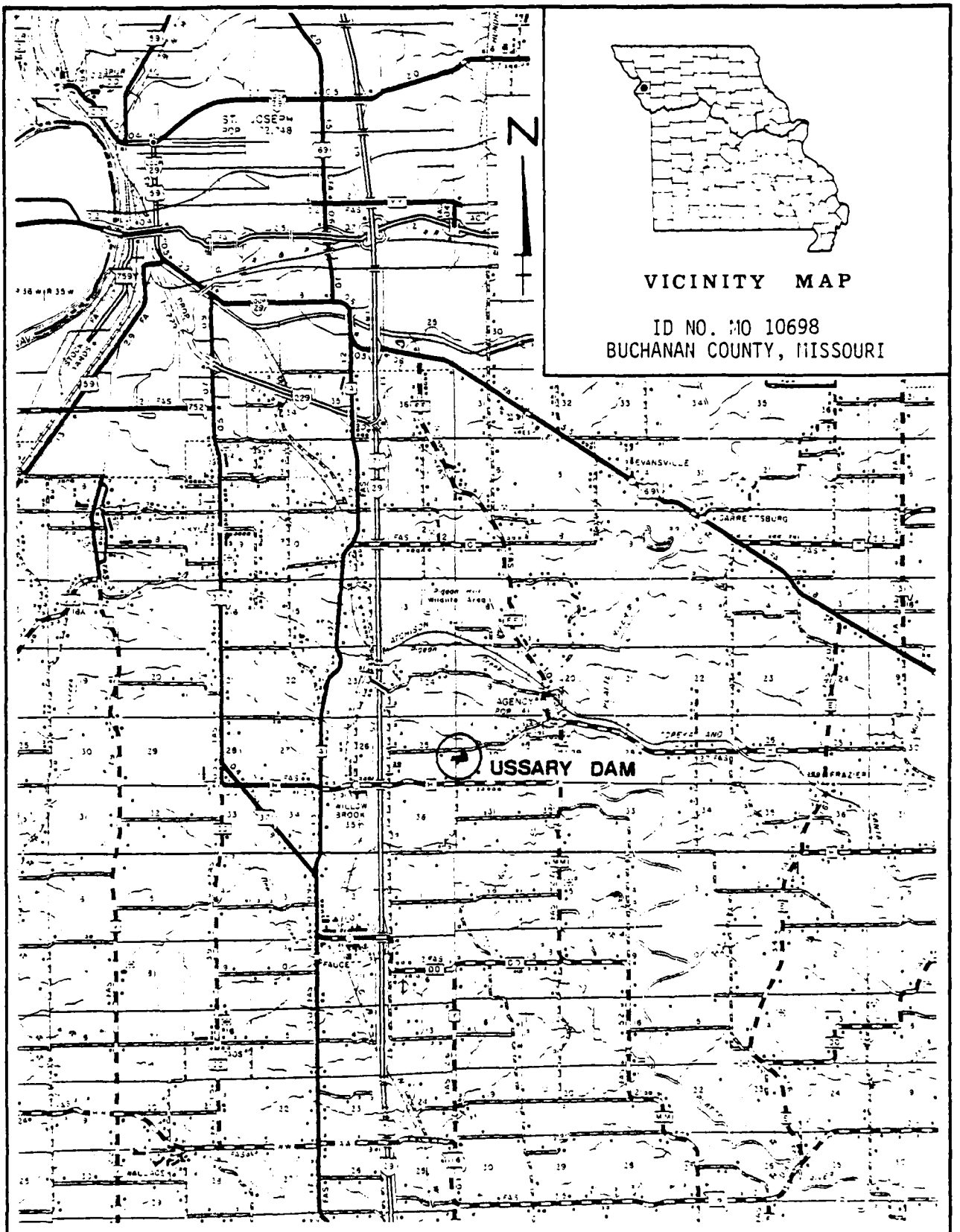
VICINITY TOPOGRAPHY

USSARY DAM

BUCHANAN COUNTY, MISSOURI

MO. 10698

PLATE A-1



LOCATION MAP

PLATE A-2

APPENDIX B
PHOTOGRAPHS

USSARY DAM
BUCHANAN COUNTY, MISSOURI
MO 10698

PHOTO INDEX

PLATE B-1

PHOTO NO. 2 - OVERVIEW FROM UPSTREAM ON LEFT

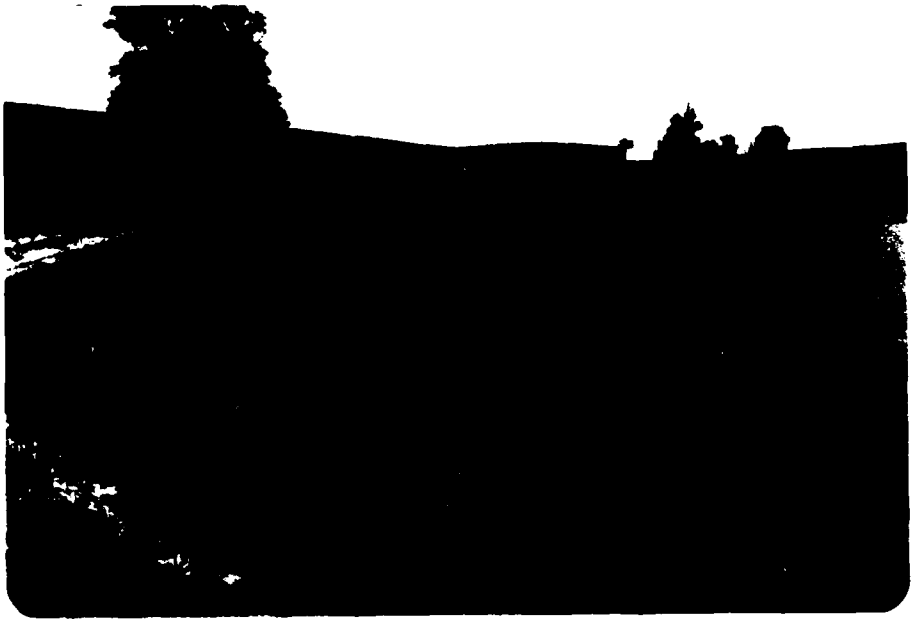


PHOTO NO. 3 - UPSTREAM SLOPE FROM LEFT END

PHOTO NO. 4 - CREST FROM LEFT END

PHOTO NO. 5 - VIEW ACROSS EMERGENCY SPILLWAY TO CREST FROM LEFT END

PHOTO NO. 6 - DOWNSTREAM SLOPE FROM LEFT END

PHOTO NO. 7 - DOWNSTREAM SLOPE FROM LEFT ABUTMENT TROUGH

PHOTO NO. 8 - VIEW UPSTREAM IN EMERGENCY SPILLWAY

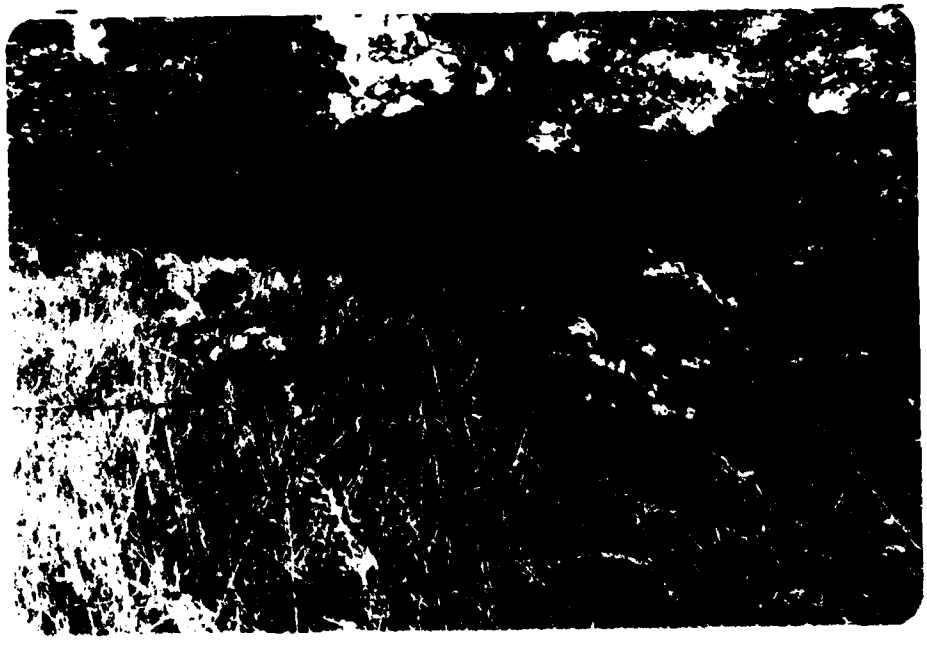


PHOTO NO. 9 - VIEW DOWNSTREAM IN EMERGENCY SPILLWAY

PHOTO NO. 10 - VIEW TAKEN FROM TOP OF DAM. MR. AND MRS. USSARY IN FOREGROUND

PHOTO NO. 11 - VIEW ACROSS LAKE FROM CENTER OF DAM

PHOTO NO. 12 - VIEW DOWNSTREAM SHOWING PRINCIPAL SPILLWAY OUTLET

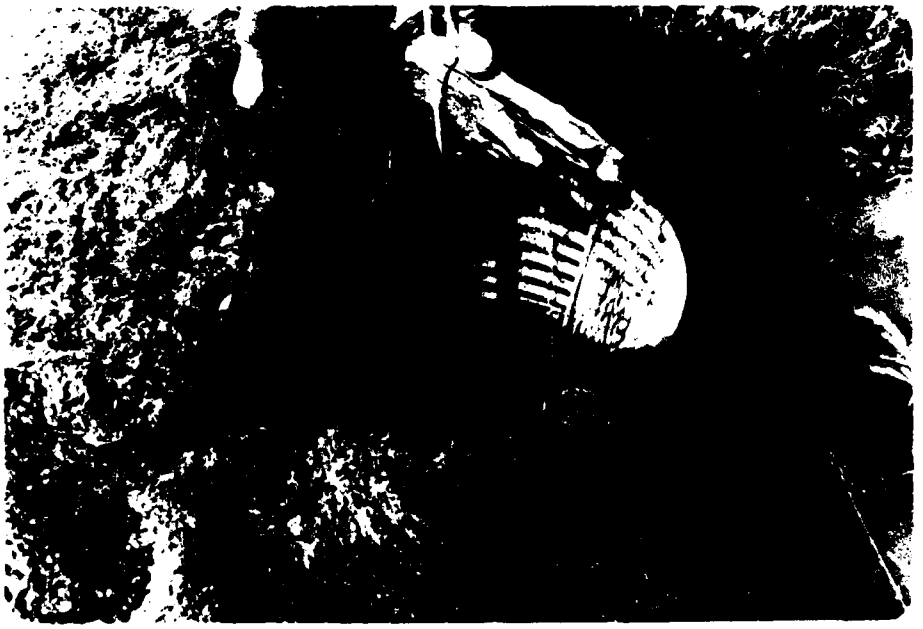


PHOTO NO. 13 - PRINCIPAL SPILLWAY RISER

PHOTO NO. 14 - VIEW DOWNSTREAM FROM OUTLET END OF PRINCIPAL SPILLWAY. EXPOSED SHALE ON RIGHT AND IN BACKGROUND

PHOTO NO. 15 - OUTLET END OF PRINCIPAL SPILLWAY SHOWING EXPOSED SHALE

PHOTO NO. 16 - HEADCUTTING IN EMERGENCY SPILLWAY APPROXIMATELY 150 FEET FROM CENTERLINE OF DAM

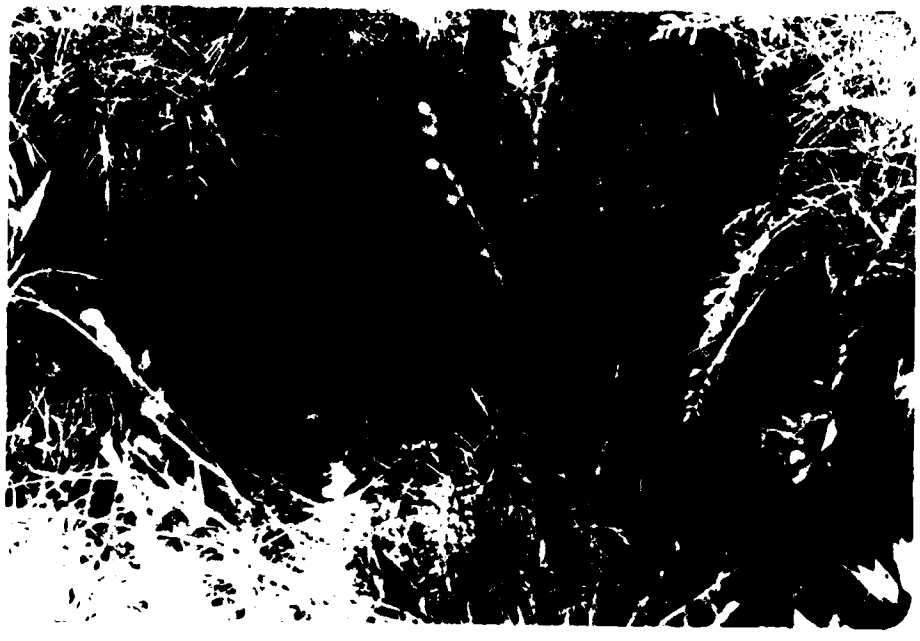


PHOTO NO. 17 - SEEPAGE AREA ON DOWNSTREAM TOE

PHOTO NO. 18 - GULLY CUT INTO SHALE IN RIGHT ABUTMENT TROUGH

PHOTO NO. 19 - SERVICE STATION AT AGENCY SHOWING STAFF GAUGE ON LIGHT POLE

PHOTO NO. 20 - BUILDING IN AGENCY. NOTE HIGH WATER MARKS

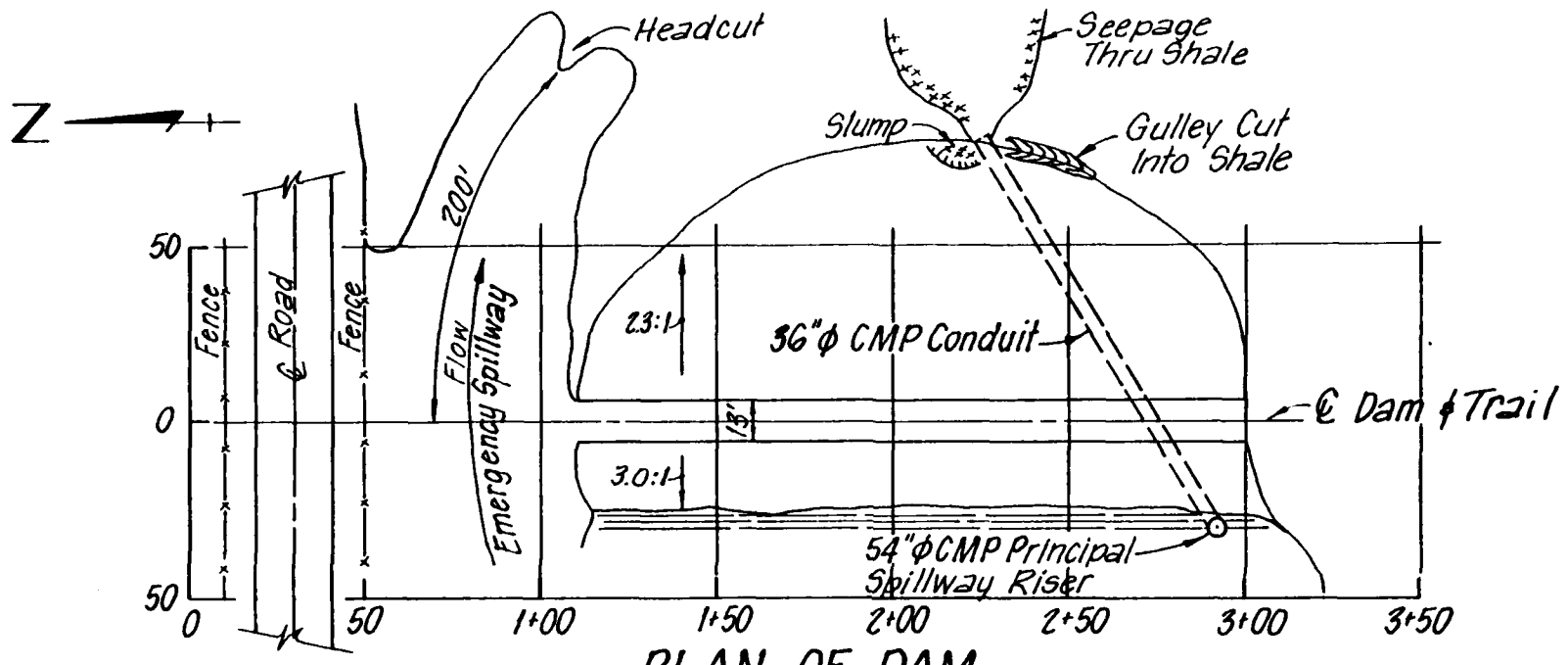
PHOTO NO. 21 - RIGHT SIDE OF POSSUM HOLLOW CREEK NEAR AGENCY

PHOTO NO. 22 - LEFT SIDE OF POSSUM HOLLOW CREEK NEAR AGENCY

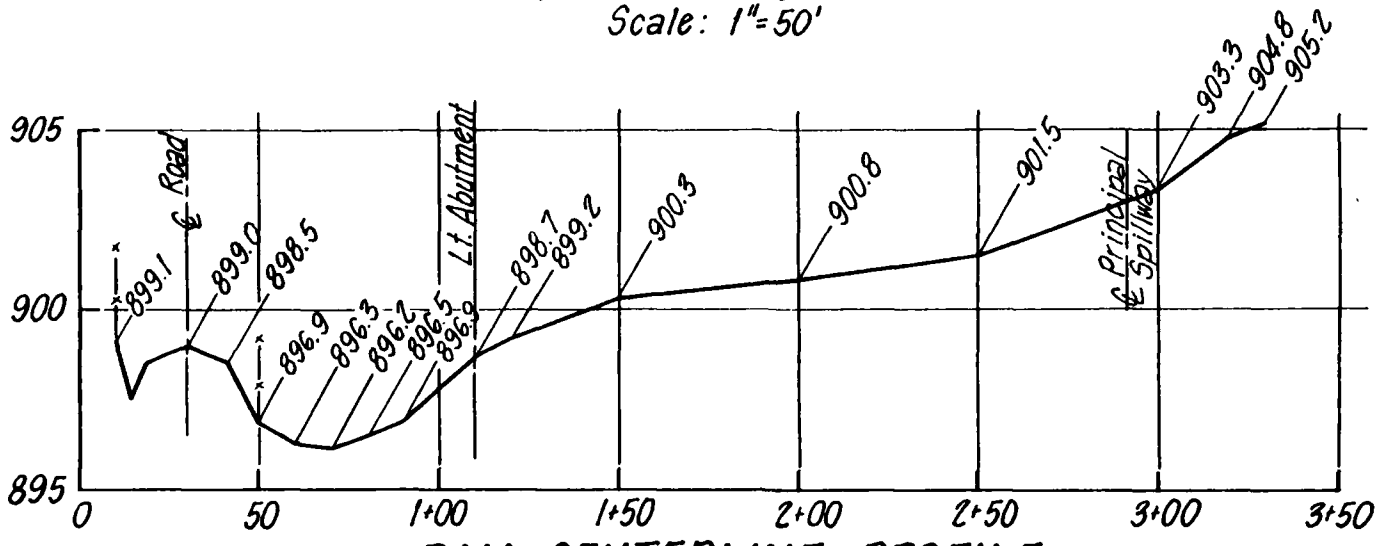
PHOTO NO. 23 - TRAILER HOUSE IN FLOODPLAIN DOWNSTREAM FROM DAM APPROXIMATELY ONE-QUARTER MILE

PHOTO NO. 24 - HOUSES ON WEST EDGE OF AGENCY

APPENDIX C
PROJECT PLATES

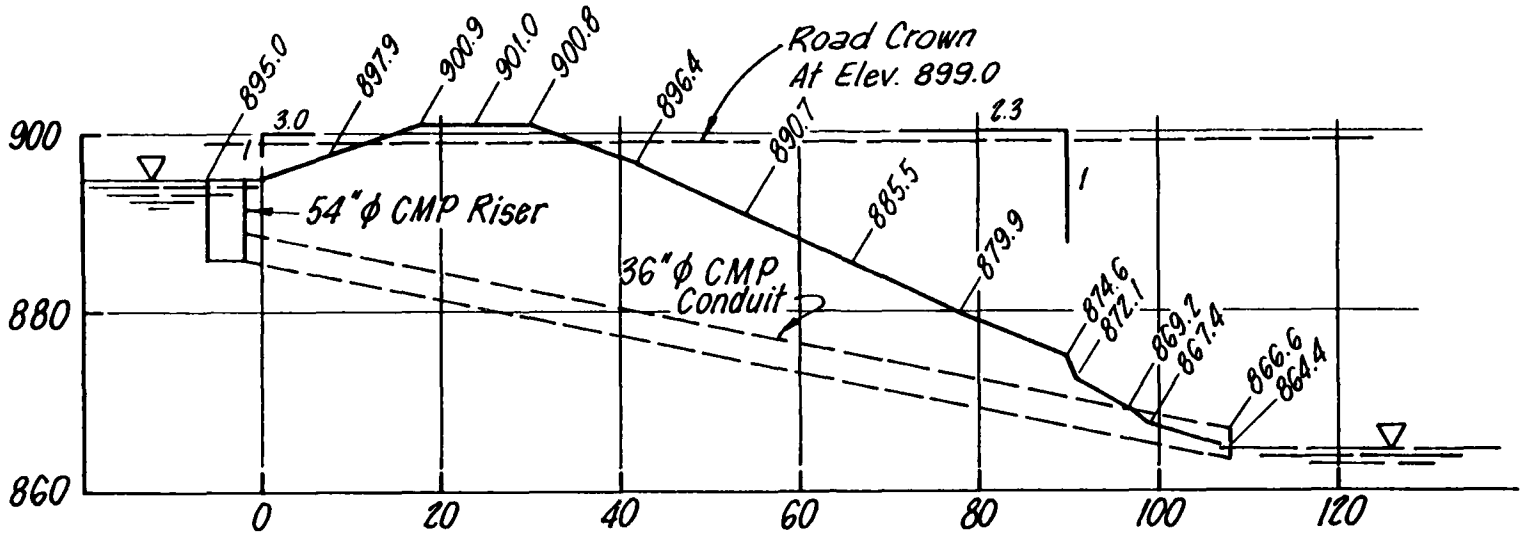


PLAN OF DAM
Scale: 1"=50'



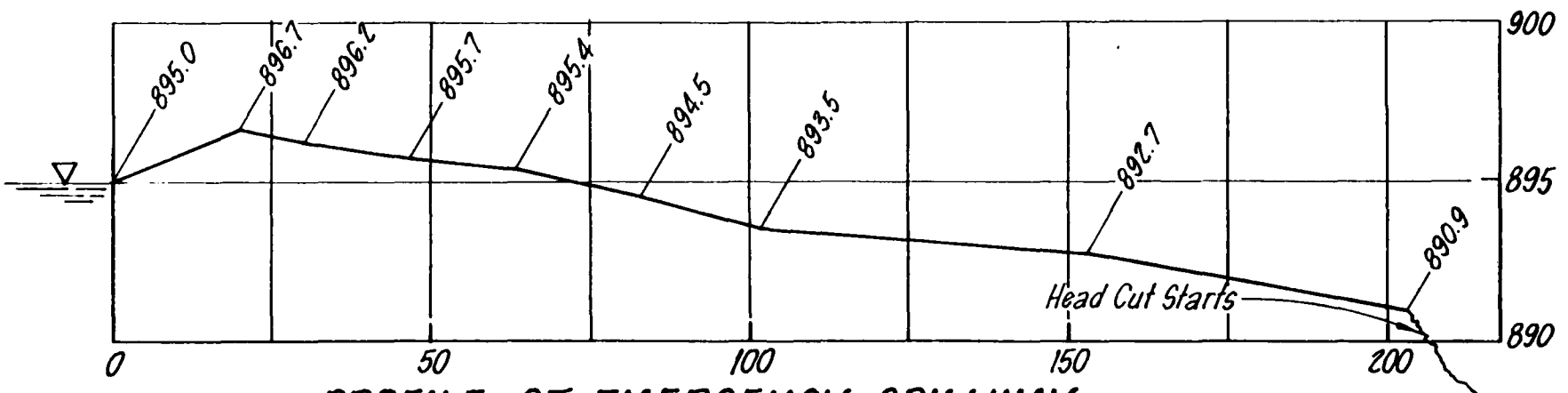
DAM CENTERLINE PROFILE
Scale: 1"=50'H. ; 1"=5'V.

PLATE C-1



MAXIMUM DAM SECTION (STA. 2+25)

Scale: 1"=20'



PROFILE OF EMERGENCY SPILLWAY

Scale: 1"=25'H.; 1"=5'V.

PLATE C-2

APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

HYDROLOGIC COMPUTATIONS

1. The SCS dimensionless unit hydrograph and systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Corps of Engineers, Davis, California, were used to develop the inflow hydrographs (See this Section).

   a. Twenty-four hour, one percent probabilistic rainfall for the dam location was taken from the data for the rainfall station at Kansas City, MO. as supplied by the St. Louis District, Corps of Engineers per their letter dated 4 March 1980. The twenty-four hour probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology.

   b. Drainage area = 0.568 square miles (363.7 acres).

   c. Time of concentration of runoff = 19.0 minutes (computed from the "Kirpich" formula).

   d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the one percent probabilistic precipitation were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the invert of the principal spillway.

      There are two small dams on the drainage from the right immediately above the dam. They store water from approximately 10 percent of the total area. They were assumed to be full and discharging 100 percent of the inflow. Their storage capacity is very small and it was assumed a breach of one or both would be of little consequence.

   e. The total twenty-four hour storm duration losses for the one percent probabilistic storm were 3.48 inches. The total losses for the PMF storm were 2.02 inches. These data are based on SCS runoff curve No. 70 and No. 85 for antecedent moisture conditions SCS AMC II and AMC III respectively. The watershed is composed entirely of SCS soil group B (Knox-Judson-McPaul Soils Association). Approximately 20 percent of the area is under cultivation and the remaining 80 percent is woods and pasture.

   f. Average soil loss rates = 0.10 inch per hour approximately (For PMF storm, AMC III).

2. The combined discharge rating consisted of three components: the flow through the principal spillway, the flow through the emergency spillway and the flow going over the top of the dam.

a. The principal spillway rating was developed by using the weir and orifice flow equations, and assuming debris has been cleared from weir crest.

1) Weir Flow equation ($Q = CLH^{1.5}$)
where C = weir coefficient = 3.4 (from SCS Engr. Memo 50)
L = effective weir length, ft. = 14.1
H = total head, ft.

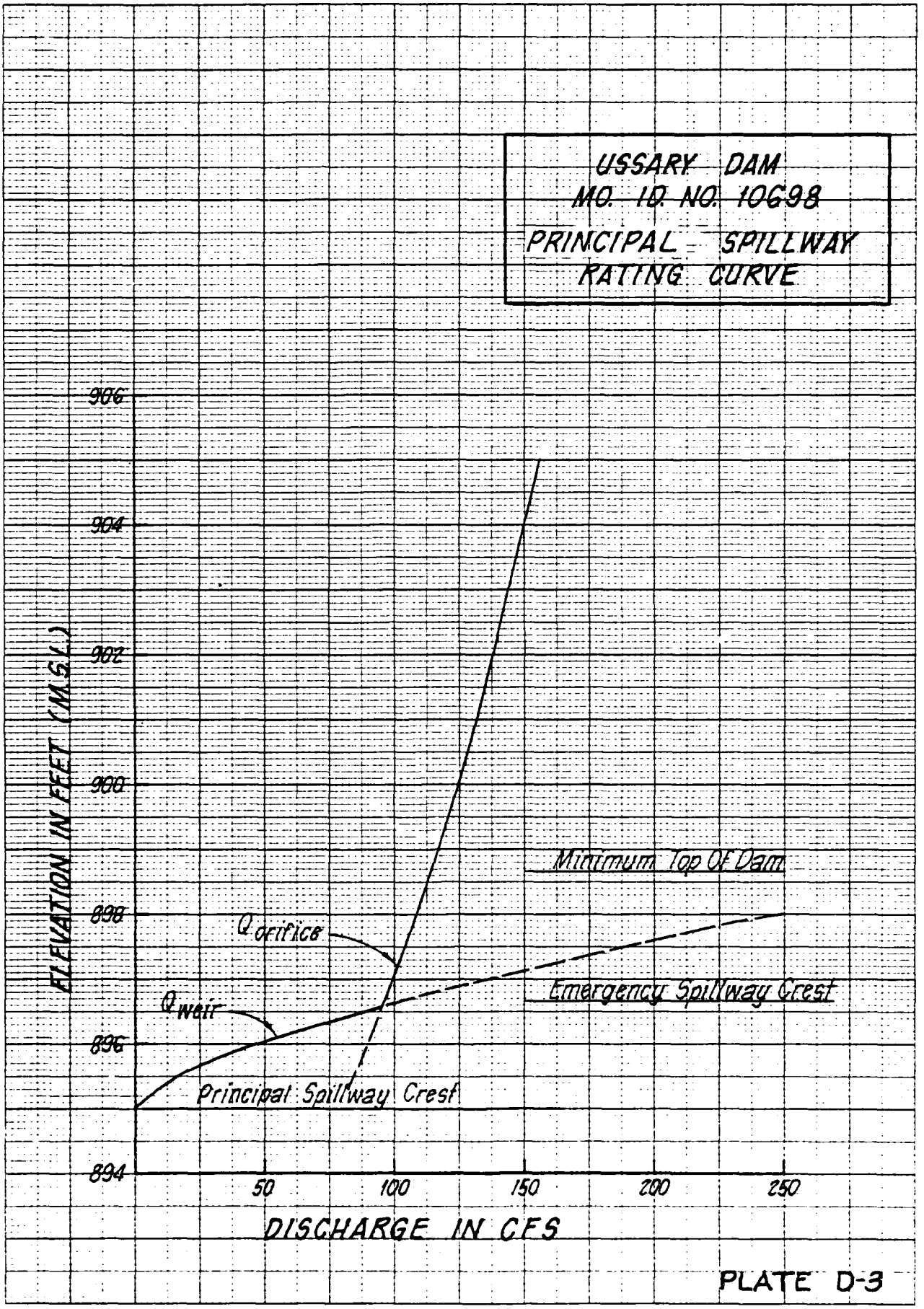
2) Orifice equation - $Q = CA\sqrt{2gh}$
where C = orifice coefficient = 0.6 for weir
0.7 for conduit entrance
(Design of Small Dams, 1977)
A^2 area of riser, sq. ft. = 15.9
A^2area of conduit, sq. ft. = 7.07
h = total head, ft.

b. The emergency spillway rating curve was developed using the Corps of Engineers, Water Surface Profile HEC-2 computer program assuming critical slope of the crest.

The flows over the north road were determined by using methods and coefficients found in USGS TWRI, Book 3, Chapter A5. The emergency spillway flows and the flows over the road were then combined.

c. The flows over the dam were determined by using the dam overtopping analyses (irregular top of dam) within the HEC-1 (Dam Safety Version) program.

3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) program to determine the capabilities of the spillway and dam embankment crest. The input, output and plotted hydrographs are attached in this Section.



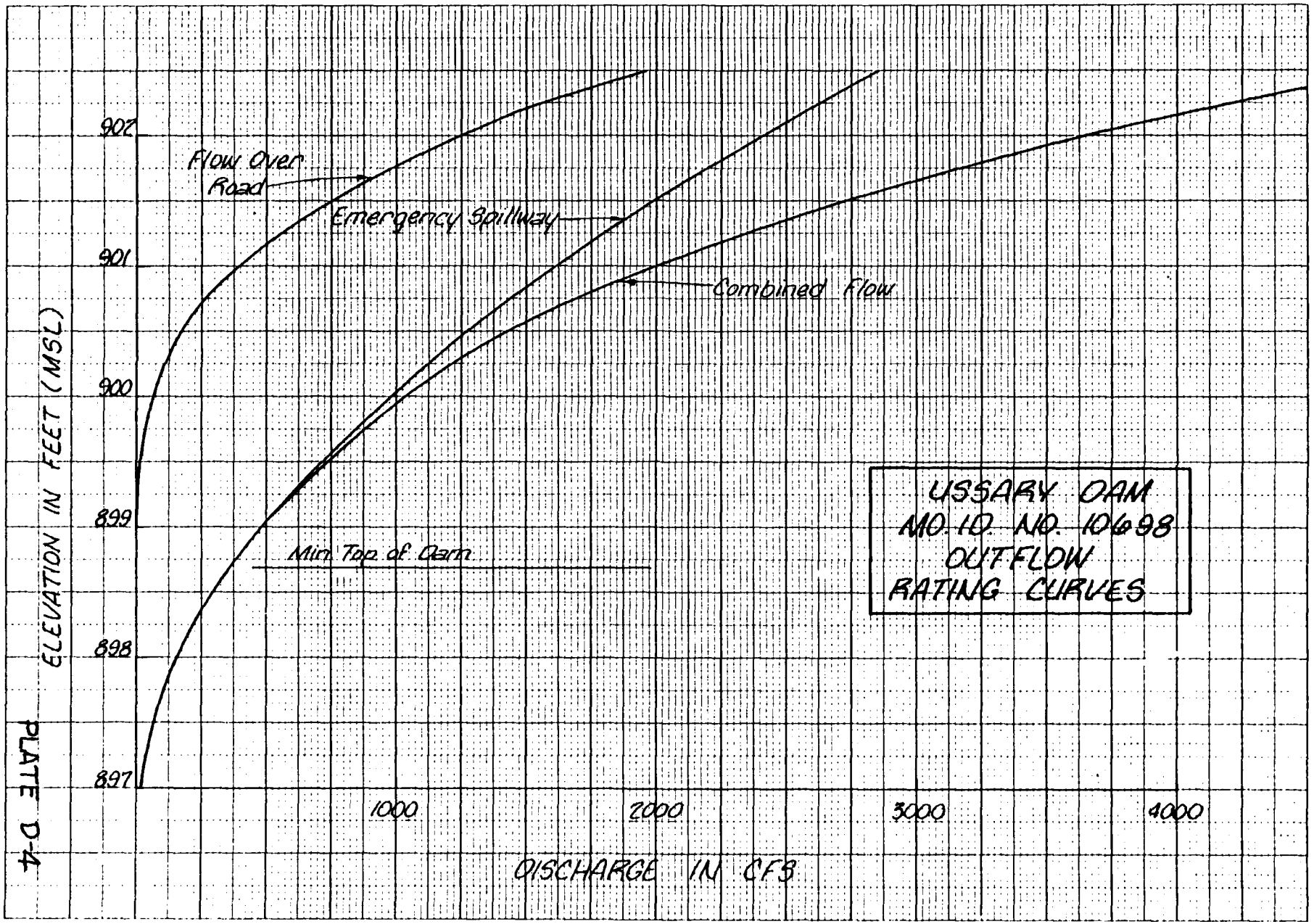


PLATE D-4

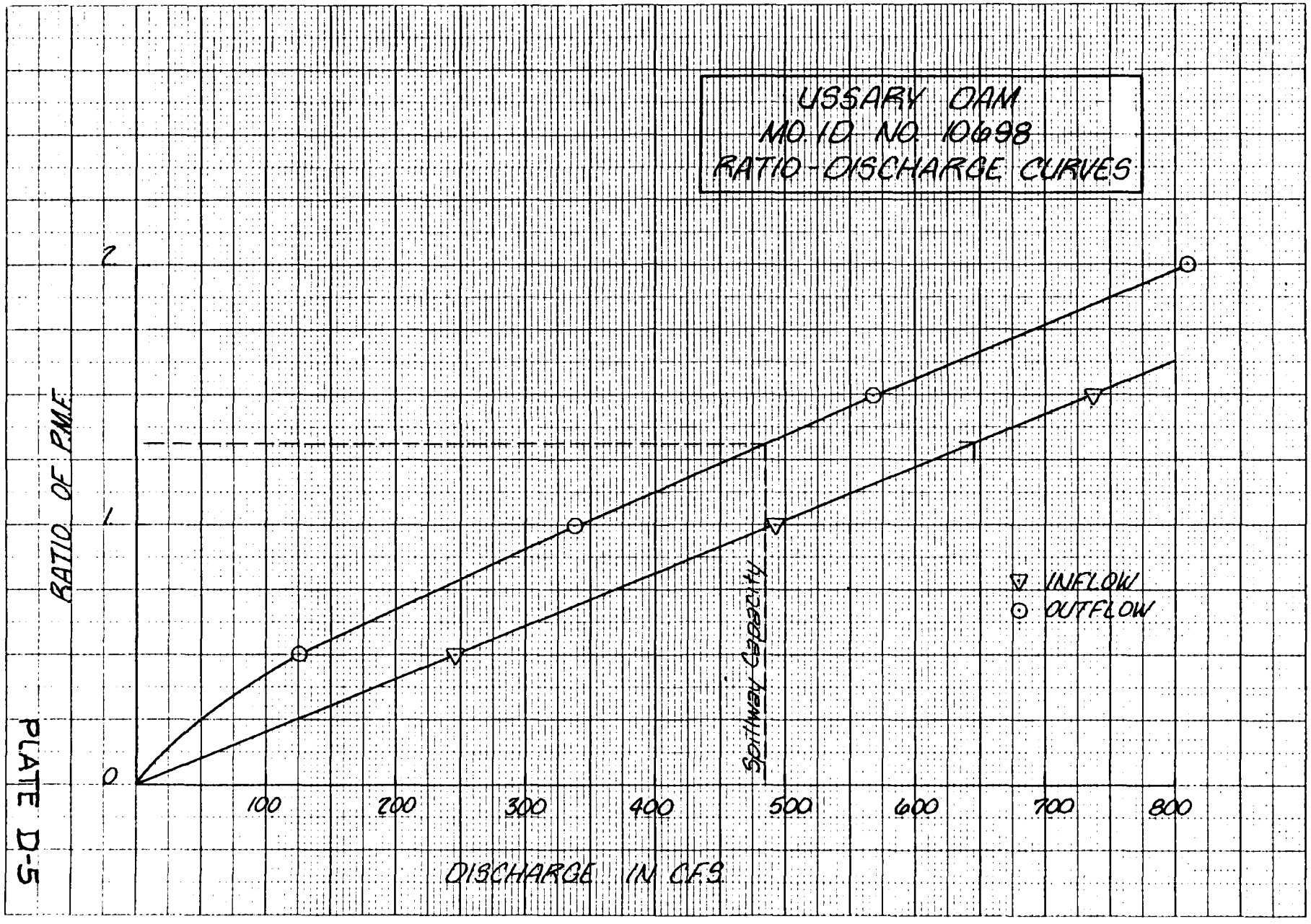


PLATE D-5

```
A1                          ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2                  H & H ANALYSIS OF SAFETY OF USSARY DAM--MO NO 10698
A3       RATIOS OF PMF ROUTED THRU THE RESERVOIR
B 0002880000000000000005                                  000000000000000000000003
B1000005
J 000001000000800000001
J1000.0500000.1000000.1500000.2000000.3500000.5000000.70000001.0
K 000000000001                      000000000000000000000001
K1       CALCULATION OF INFLOW HYDRO TO USSARY RESERVOIR
M 000001000000020000.563            0000.568000001.0                    00000001
P 000000000024.200000102000001210000130
T                                                        -1.0    -85.0
W2       0000.317
X 000000     -.0100000001
K 000001000000002                   000000020000000000000001
K1       ROUTED FLOWS THRU USSARY RESERVOIR
Y                           000000010000000 1
Y1000001                                                -895.0      -1
Y4 895.0    895.2    895.5    896.0    896.6    897.0    898.0    898.7    899.0    900.0
Y4 901.0    902.0    902.5
Y5      0      4.3       17       48       96      110      258      484      607     1154
Y5   2132     3768     4941
$A000000000000.9000001.7000002.9000004.6000006.1000009.8000011.7000014.2
$E000870000008800000088500000890000008950000089700000900000009020000905
$$000895
$D0898.7000002.8000001.500000190
$L000000000000100000004000000090000001 4000000190
$V0898.7000899.2000900.3000900.8000901.5000903.3
K 000099
A
A
A
A
A
```

PLATE D-6

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********************************

RUN  DATE= 80/07/08.
     TIME= 13.07.00.
```

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
H & H ANALYSIS OF SAFETY OF USSARY DAM--NO NO 10693
RATIOS OF PMF ROUTED THRU THE RESERVOIR

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	3	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 8 LRTIO= 1

RTIOS= .05 .10 .15 .20 .35 .50 .70 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

CALCULATION OF INFLOW HYDRO TO USSARY RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
000001	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.57	0.00	.57	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.20	102.00	121.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRTR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-85.00	0.00	0.00

CURVE NO = -85.00 WETNESS = -1.00 EFFECT CN = 85.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .32

RECESSION DATA
STRTQ= 0.00 QRCSN= -.01 RTIOR= 1.00

UNIT HYDROGRAPH 21 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .32 VOL= 1.00

99.	314.	623.	759.	728.	600.	408.	271.	189.	130.
89.	60.	41.	28.	20.	13.	9.	7.	5.	3.
1.									

PLATE D-7

END OF PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	0.	1.01	12.05	145	.21	.19	.01	274.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.10	146	.21	.19	.01	316.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.15	147	.21	.19	.01	400.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.20	148	.21	.19	.01	502.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.25	149	.21	.20	.01	600.
1.01	.30	6	.01	0.00	.01	0.	1.01	12.30	150	.21	.20	.01	681.
1.01	.35	7	.01	0.00	.01	0.	1.01	12.35	151	.21	.20	.01	738.
1.01	.40	8	.01	0.00	.01	0.	1.01	12.40	152	.21	.20	.01	776.
1.01	.45	9	.01	0.00	.01	0.	1.01	12.45	153	.21	.20	.01	803.
1.01	.50	10	.01	0.00	.01	0.	1.01	12.50	154	.21	.20	.01	822.
1.01	.55	11	.01	0.00	.01	0.	1.01	12.55	155	.21	.20	.01	836.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.00	156	.21	.20	.01	846.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.05	157	.25	.24	.01	858.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.10	158	.25	.24	.01	876.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.15	159	.25	.24	.01	905.
1.01	1.20	16	.01	0.00	.01	0.	1.01	13.20	160	.25	.24	.01	938.
1.01	1.25	17	.01	0.00	.01	0.	1.01	13.25	161	.25	.24	.01	970.
1.01	1.30	18	.01	0.00	.01	0.	1.01	13.30	162	.25	.24	.01	997.
1.01	1.35	19	.01	0.00	.01	0.	1.01	13.35	163	.25	.24	.01	1015.
1.01	1.40	20	.01	0.00	.01	0.	1.01	13.40	164	.25	.24	.01	1028.
1.01	1.45	21	.01	0.00	.01	0.	1.01	13.45	165	.25	.24	.01	1037.
1.01	1.50	22	.01	0.00	.01	0.	1.01	13.50	166	.25	.24	.01	1044.
1.01	1.55	23	.01	0.00	.01	0.	1.01	13.55	167	.25	.24	.01	1049.
1.01	2.00	24	.01	0.00	.01	0.	1.01	14.00	168	.25	.24	.01	1052.
1.01	2.05	25	.01	0.00	.01	0.	1.01	14.05	169	.31	.30	.01	1061.
1.01	2.10	26	.01	0.00	.01	0.	1.01	14.10	170	.31	.30	.01	1082.
1.01	2.15	27	.01	0.00	.01	0.	1.01	14.15	171	.31	.30	.01	1122.
1.01	2.20	28	.01	0.00	.01	0.	1.01	14.20	172	.31	.30	.01	1170.
1.01	2.25	29	.01	0.00	.01	0.	1.01	14.25	173	.31	.30	.01	1215.
1.01	2.30	30	.01	.00	.01	0.	1.01	14.30	174	.31	.30	.00	1253.
1.01	2.35	31	.01	.00	.01	0.	1.01	14.35	175	.31	.30	.00	1279.
1.01	2.40	32	.01	.00	.01	0.	1.01	14.40	176	.31	.30	.00	1296.
1.01	2.45	33	.01	.00	.01	0.	1.01	14.45	177	.31	.30	.00	1309.
1.01	2.50	34	.01	.00	.01	1.	1.01	14.50	178	.31	.30	.00	1318.
1.01	2.55	35	.01	.00	.01	1.	1.01	14.55	179	.31	.30	.00	1324.
1.01	3.00	36	.01	.00	.01	2.	1.01	15.00	180	.31	.30	.00	1328.
1.01	3.05	37	.01	.00	.01	2.	1.01	15.05	181	.19	.19	.00	1320.
1.01	3.10	38	.01	.00	.01	3.	1.01	15.10	182	.38	.37	.00	1303.
1.01	3.15	39	.01	.00	.01	3.	1.01	15.15	183	.38	.37	.00	1289.
1.01	3.20	40	.01	.00	.01	4.	1.01	15.20	184	.56	.56	.01	1334.
1.01	3.25	41	.01	.00	.01	5.	1.01	15.25	185	.66	.65	.01	1456.
1.01	3.30	42	.01	.00	.01	5.	1.01	15.30	186	1.59	1.58	.01	1758.
1.01	3.35	43	.01	.00	.01	6.	1.01	15.35	187	2.63	2.61	.02	2415.
1.01	3.40	44	.01	.00	.01	6.	1.01	15.40	188	1.03	1.03	.01	3413.
1.01	3.45	45	.01	.00	.01	7.	1.01	15.45	189	.66	.65	.00	4430.
1.01	3.50	46	.01	.00	.01	8.	1.01	15.50	190	.56	.56	.00	4925.
1.01	3.55	47	.01	.00	.01	8.	1.01	15.55	191	.38	.37	.00	4853.
1.01	4.00	48	.01	.00	.01	9.	1.01	16.00	192	.38	.37	.00	4366.
1.01	4.05	49	.01	.00	.01	9.	1.01	16.05	193	.29	.29	.00	3670.
1.01	4.10	50	.01	.00	.01	10.	1.01	16.10	194	.29	.29	.00	3051.
1.01	4.15	51	.01	.00	.01	10.	1.01	16.15	195	.29	.29	.00	2541.
1.01	4.20	52	.01	.00	.01	11.	1.01	16.20	196	.29	.29	.00	2177.
1.01	4.25	53	.01	.00	.01	11.	1.01	16.25	197	.29	.29	.00	1895.
1.01	4.30	54	.01	.00	.01	12.	1.01	16.30	198	.29	.29	.00	1693.
1.01	4.35	55	.01	.00	.01	12.	1.01	16.35	199	.29	.29	.00	1556.
1.01	4.40	56	.01	.00	.01	13.	1.01	16.40	200	.29	.29	.00	1464.
1.01	4.45	57	.01	.00	.01	13.	1.01	16.45	201	.29	.29	.00	1400.
1.01	4.50	58	.01	.00	.01	14.	1.01	16.50	202	.29	.29	.00	1356.
1.01	4.55	59	.01	.00	.01	14.	1.01	16.55	203	.29	.29	.00	1327.

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FROM [illegible]

PLATE D-8

1.01	5.00	60	.01	.00	.01	15.	1.01	17.00	204	.29	.29	.00	1307.
1.01	5.05	61	.01	.00	.01	15.	1.01	17.05	205	.23	.23	.00	1285.
1.01	5.10	62	.01	.00	.01	16.	1.01	17.10	206	.23	.23	.00	1254.
1.01	5.15	63	.01	.00	.01	16.	1.01	17.15	207	.23	.23	.00	1207.
1.01	5.20	64	.01	.00	.01	16.	1.01	17.20	208	.23	.23	.00	1155.
1.01	5.25	65	.01	.00	.01	17.	1.01	17.25	209	.23	.23	.00	1108.
1.01	5.30	66	.01	.00	.01	17.	1.01	17.30	210	.23	.23	.00	1070.
1.01	5.35	67	.01	.00	.01	18.	1.01	17.35	211	.23	.23	.00	1045.
1.01	5.40	68	.01	.00	.01	18.	1.01	17.40	212	.23	.23	.00	1028.
1.01	5.45	69	.01	.00	.01	18.	1.01	17.45	213	.23	.23	.00	1016.
1.01	5.50	70	.01	.00	.01	19.	1.01	17.50	214	.23	.23	.00	1008.
1.01	5.55	71	.01	.00	.01	19.	1.01	17.55	215	.23	.23	.00	1003.
1.01	6.00	72	.01	.00	.01	20.	1.01	18.00	216	.23	.23	.00	999.
1.01	6.05	73	.06	.03	.04	22.	1.01	18.05	217	.02	.02	.00	976.
1.01	6.10	74	.06	.03	.04	30.	1.01	18.10	218	.02	.02	.00	909.
1.01	6.15	75	.06	.03	.03	44.	1.01	18.15	219	.02	.02	.00	779.
1.01	6.20	76	.06	.03	.03	63.	1.01	18.20	220	.02	.02	.00	620.
1.01	6.25	77	.06	.03	.03	82.	1.01	18.25	221	.02	.02	.00	469.
1.01	6.30	78	.06	.04	.03	100.	1.01	18.30	222	.02	.02	.00	344.
1.01	6.35	79	.06	.04	.03	115.	1.01	18.35	223	.02	.02	.00	259.
1.01	6.40	80	.06	.04	.03	126.	1.01	18.40	224	.02	.02	.00	203.
1.01	6.45	81	.06	.04	.02	136.	1.01	18.45	225	.02	.02	.00	164.
1.01	6.50	82	.06	.04	.02	145.	1.01	18.50	226	.02	.02	.00	137.
1.01	6.55	83	.06	.04	.02	153.	1.01	18.55	227	.02	.02	.00	118.
1.01	7.00	84	.06	.04	.02	159.	1.01	19.00	228	.02	.02	.00	106.
1.01	7.05	85	.06	.04	.02	165.	1.01	19.05	229	.02	.02	.00	97.
1.01	7.10	86	.06	.04	.02	171.	1.01	19.10	230	.02	.02	.00	91.
1.01	7.15	87	.06	.04	.02	176.	1.01	19.15	231	.02	.02	.00	87.
1.01	7.20	88	.06	.05	.02	181.	1.01	19.20	232	.02	.02	.00	85.
1.01	7.25	89	.06	.05	.02	185.	1.01	19.25	233	.02	.02	.00	83.
1.01	7.30	90	.06	.05	.02	189.	1.01	19.30	234	.02	.02	.00	81.
1.01	7.35	91	.06	.05	.02	193.	1.01	19.35	235	.02	.02	.00	80.
1.01	7.40	92	.06	.05	.02	196.	1.01	19.40	236	.02	.02	.00	80.
1.01	7.45	93	.06	.05	.02	200.	1.01	19.45	237	.02	.02	.00	80.
1.01	7.50	94	.06	.05	.01	203.	1.01	19.50	238	.02	.02	.00	80.
1.01	7.55	95	.06	.05	.01	206.	1.01	19.55	239	.02	.02	.00	80.
1.01	8.00	96	.06	.05	.01	208.	1.01	20.00	240	.02	.02	.00	80.
1.01	8.05	97	.06	.05	.01	211.	1.01	20.05	241	.02	.02	.00	80.
1.01	8.10	98	.06	.05	.01	213.	1.01	20.10	242	.02	.02	.00	80.
1.01	8.15	99	.06	.05	.01	216.	1.01	20.15	243	.02	.02	.00	80.
1.01	8.20	100	.06	.05	.01	218.	1.01	20.20	244	.02	.02	.00	80.
1.01	8.25	101	.06	.05	.01	220.	1.01	20.25	245	.02	.02	.00	80.
1.01	8.30	102	.06	.05	.01	222.	1.01	20.30	246	.02	.02	.00	80.
1.01	8.35	103	.06	.05	.01	224.	1.01	20.35	247	.02	.02	.00	80.
1.01	8.40	104	.06	.05	.01	226.	1.01	20.40	248	.02	.02	.00	80.
1.01	8.45	105	.06	.05	.01	228.	1.01	20.45	249	.02	.02	.00	80.
1.01	8.50	106	.06	.05	.01	229.	1.01	20.50	250	.02	.02	.00	80.
1.01	8.55	107	.06	.05	.01	231.	1.01	20.55	251	.02	.02	.00	80.
1.01	9.00	108	.06	.05	.01	232.	1.01	21.00	252	.02	.02	.00	80.
1.01	9.05	109	.06	.05	.01	234.	1.01	21.05	253	.02	.02	.00	80.
1.01	9.10	110	.06	.05	.01	235.	1.01	21.10	254	.02	.02	.00	80.
1.01	9.15	111	.06	.06	.01	236.	1.01	21.15	255	.02	.02	.00	80.
1.01	9.20	112	.06	.06	.01	238.	1.01	21.20	256	.02	.02	.00	80.
1.01	9.25	113	.06	.06	.01	239.	1.01	21.25	257	.02	.02	.00	80.
1.01	9.30	114	.06	.06	.01	240.	1.01	21.30	258	.02	.02	.00	80.
1.01	9.35	115	.06	.06	.01	241.	1.01	21.35	259	.02	.02	.00	80.
1.01	9.40	116	.06	.06	.01	242.	1.01	21.40	260	.02	.02	.00	80.
1.01	9.45	117	.06	.06	.01	243.	1.01	21.45	261	.02	.02	.00	80.
1.01	9.50	118	.06	.06	.01	244.	1.01	21.50	262	.02	.02	.00	80.
1.01	9.55	119	.06	.06	.01	245.	1.01	21.55	263	.02	.02	.00	80.
1.01	10.00	120	.06	.06	.01	246.	1.01	22.00	264	.02	.02	.00	80.
1.01	10.05	121	.06	.06	.01	247.	1.01	22.05	265	.02	.02	.00	80.

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1.01	10.10	122	.06	.06	.01	248.	1.01	22.10	264	.02	.02	.00	80.
1.01	10.15	123	.06	.06	.01	248.	1.01	22.15	267	.02	.02	.00	80.
1.01	10.20	124	.06	.06	.01	249.	1.01	22.20	268	.02	.02	.00	80.
1.01	10.25	125	.06	.06	.01	250.	1.01	22.25	269	.02	.02	.00	80.
1.01	10.30	126	.06	.06	.01	251.	1.01	22.30	270	.02	.02	.00	80.
1.01	10.35	127	.06	.06	.01	251.	1.01	22.35	271	.02	.02	.00	80.
1.01	10.40	128	.06	.06	.01	252.	1.01	22.40	272	.02	.02	.00	80.
1.01	10.45	129	.06	.06	.01	253.	1.01	22.45	273	.02	.02	.00	80.
1.01	10.50	130	.06	.06	.01	253.	1.01	22.50	274	.02	.02	.00	80.
1.01	10.55	131	.06	.06	.01	254.	1.01	22.55	275	.02	.02	.00	80.
1.01	11.00	132	.06	.06	.01	255.	1.01	23.00	276	.02	.02	.00	80.
1.01	11.05	133	.06	.06	.01	255.	1.01	23.05	277	.02	.02	.00	80.
1.01	11.10	134	.06	.06	.01	256.	1.01	23.10	278	.02	.02	.00	80.
1.01	11.15	135	.06	.06	.01	256.	1.01	23.15	279	.02	.02	.00	80.
1.01	11.20	136	.06	.06	.00	257.	1.01	23.20	280	.02	.02	.00	80.
1.01	11.25	137	.06	.06	.00	257.	1.01	23.25	281	.02	.02	.00	80.
1.01	11.30	138	.06	.06	.00	258.	1.01	23.30	282	.02	.02	.00	80.
1.01	11.35	139	.06	.06	.00	258.	1.01	23.35	283	.02	.02	.00	80.
1.01	11.40	140	.06	.06	.00	259.	1.01	23.40	284	.02	.02	.00	80.
1.01	11.45	141	.06	.06	.00	259.	1.01	23.45	285	.02	.02	.00	80.
1.01	11.50	142	.06	.06	.00	260.	1.01	23.50	286	.02	.02	.00	80.
1.01	11.55	143	.06	.06	.00	260.	1.01	23.55	287	.02	.02	.00	80.
1.01	12.00	144	.06	.06	.00	260.	1.02	0.00	288	.02	.02	.00	80.
									SUM	31.46	29.44	2.02	129075.
										(799.)	(748.)	(51.)	(3655.00)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4925.	1463.	448.	448.	129012.
CMS	139.	41.	13.	13.	3653.
INCHES		23.96	29.35	29.35	29.35
MM		608.66	745.37	745.37	745.37
AC-FT		726.	889.	889.	889.
THOUS CU M		895.	1096.	1096.	1096.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	246.	73.	22.	22.	6451.
CMS	7.	2.	1.	1.	183.
INCHES		1.20	1.47	1.47	1.47
MM		30.43	37.27	37.27	37.27
AC-FT		36.	44.	44.	44.
THOUS CU M		45.	55.	55.	55.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	493.	146.	45.	45.	12901.
CMS	14.	4.	1.	1.	365.
INCHES		2.40	2.93	2.93	2.93
MM		60.87	74.54	74.54	74.54
AC-FT		73.	89.	89.	89.
THOUS CU M		89.	110.	110.	110.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 3

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	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	739.	219.	67.	67.	19352.
CMS	21.	6.	2.	2.	548.
INCHES		3.59	4.40	4.40	4.40
MM		91.30	111.81	111.81	111.81
AC-FT		109.	133.	133.	133.
THOUS CU M		134.	164.	164.	164.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	985.	293.	90.	90.	25802.
CMS	28.	8.	3.	3.	731.
INCHES		4.79	5.87	5.87	5.87
MM		121.73	149.07	149.07	149.07
AC-FT		145.	178.	178.	178.
THOUS CU M		179.	219.	219.	219.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1724.	512.	157.	157.	45154.
CMS	49.	15.	4.	4.	1279.
INCHES		8.39	10.27	10.27	10.27
MM		213.03	260.88	260.88	260.88
AC-FT		254.	311.	311.	311.
THOUS CU M		313.	384.	384.	384.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 6 [1/2 PMF]

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2463.	732.	224.	224.	64506.
CMS	70.	21.	6.	6.	1827.
INCHES		11.98	14.67	14.67	14.67
MM		304.33	372.69	372.69	372.69
AC-FT		363.	444.	444.	444.
THOUS CU M		447.	548.	548.	548.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 7

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3448.	1024.	314.	314.	90308.
CMS	98.	29.	9.	9.	2557.
INCHES		14.77	20.54	20.54	20.54
MM		424.04	521.76	521.76	521.76
AC-FT		508.	622.	622.	622.
THOUS CU M		626.	767.	767.	767.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 8 [PMF]

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME

CFS	4925.	1463.	448.	448.	129012.
CMS	139.	41.	13.	13.	3653.
INCHES		23.96	29.35	29.35	29.35
MM		608.66	745.37	745.37	745.37
AC-FT		726.	889.	889.	889.
THOUS CU M		895.	1096.	1096.	1096.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTED FLOWS THRU USSARY RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
000002	1	0	0	2	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-895.	-1

STAGE	895.00	895.20	895.50	896.00	896.60	897.00	898.00	898.70	899.00	900.00
	901.00	902.00	902.50							
FLOW	0.00	4.30	17.00	48.00	96.00	110.00	258.00	484.00	607.00	1154.00
	2132.00	3768.00	4941.00							

SURFACE AREA=	0.	1.	2.	3.	5.	6.	10.	12.	14.
CAPACITY=	0.	3.	9.	21.	39.	50.	74.	95.	134.
ELEVATION=	870.	880.	885.	890.	895.	897.	900.	902.	905.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
895.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
898.7	2.8	1.5	190.

CREST LENGTH	0.	10.	40.	90.	140.	190.
AT OR BELOW ELEVATION	898.7	899.2	900.3	900.8	901.5	903.3

~~STATION 000002, PLAN 1, RATIO 1~~

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.	1.	1.	1.	1.	1.

#OVN#

STATION 000002, PLAN 1, RATIO 6 [1/2 PMF]

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.	1.	1.	1.	1.	1.
1.	1.	2.	2.	2.	2.	2.	2.	2.	3.
3.	3.	3.	3.	3.	3.	4.	4.	4.	4.
4.	5.	5.	5.	6.	7.	9.	11.	14.	16.
20.	24.	28.	32.	36.	40.	43.	47.	51.	55.
59.	63.	66.	69.	73.	75.	78.	81.	83.	86.
88.	90.	92.	94.	95.	97.	97.	98.	99.	99.
100.	101.	102.	102.	103.	104.	104.	105.	106.	106.
107.	108.	108.	109.	110.	111.	113.	115.	117.	118.
119.	121.	122.	123.	123.	124.	125.	125.	126.	126.
127.	127.	128.	128.	129.	132.	139.	152.	170.	191.
214.	236.	257.	296.	327.	351.	370.	386.	401.	415.
431.	445.	459.	472.	482.	493.	502.	509.	514.	521.
530.	542.	558.	575.	592.	607.	623.	635.	644.	651.
655.	655.	653.	654.	670.	719.	837.	1065.	1491.	1970.
2250.	2282.	2119.	1864.	1604.	1371.	1186.	1079.	981.	898.
831.	779.	740.	710.	688.	668.	649.	628.	606.	588.
571.	556.	543.	532.	524.	517.	510.	499.	477.	446.
403.	353.	300.	255.	233.	211.	191.	172.	154.	138.
124.	112.	108.	105.	103.	100.	98.	94.	89.	85.
81.	77.	73.	70.	67.	65.	62.	60.	58.	56.
55.	53.	52.	51.	50.	49.	48.	47.	47.	46.
46.	45.	45.	44.	44.	44.	43.	43.	43.	43.
42.	42.	42.	42.	42.	42.	41.	41.	41.	41.
41.	41.	41.	41.	41.	41.	40.	40.		

STORAGE

39.	39.	39.	39.	39.	39.	39.	39.	39.	39.
39.	39.	39.	39.	39.	39.	39.	39.	39.	39.
39.	39.	39.	39.	39.	39.	39.	39.	39.	39.
39.	39.	39.	39.	39.	39.	39.	39.	39.	39.
39.	39.	39.	39.	39.	39.	40.	40.	40.	40.
40.	40.	40.	40.	40.	40.	40.	40.	40.	40.
40.	40.	40.	40.	40.	40.	40.	40.	40.	40.
40.	40.	40.	40.	40.	41.	41.	41.	41.	42.
42.	42.	43.	43.	43.	44.	44.	44.	45.	45.
45.	45.	46.	46.	46.	46.	46.	47.	47.	47.
47.	47.	47.	47.	48.	48.	48.	48.	48.	48.
48.	48.	49.	49.	49.	49.	49.	49.	49.	49.
50.	50.	50.	50.	50.	50.	50.	50.	50.	50.
50.	50.	50.	51.	51.	51.	51.	51.	51.	51.
51.	51.	51.	51.	51.	51.	51.	52.	53.	54.
55.	56.	57.	58.	58.	59.	59.	60.	60.	60.
61.	61.	61.	62.	62.	62.	62.	63.	63.	63.
63.	63.	64.	64.	64.	64.	65.	65.	65.	65.
65.	65.	65.	65.	65.	66.	68.	72.	76.	80.
83.	83.	82.	80.	77.	75.	73.	72.	70.	69.
68.	67.	67.	66.	66.	65.	65.	65.	64.	64.
64.	63.	63.	63.	63.	63.	63.	62.	62.	61.
60.	59.	58.	57.	55.	54.	54.	53.	52.	51.
51.	50.	50.	49.	49.	48.	48.	48.	47.	47.

47.	46.	46.	46.	46.	45.	45.	45.	45.	45.
45.	45.	45.	44.	44.	44.	44.	44.	44.	44.
44.	44.	44.	44.	44.	44.	44.	44.	44.	44.
44.	44.	44.	44.	44.	44.	44.	44.	44.	44.
44.	44.	44.	44.	44.	44.	44.	44.		

STAGE

895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0
895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0
895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0
895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0
895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.1
895.1	895.1	895.1	895.1	895.1	895.1	895.1	895.1	895.1	895.1
895.1	895.1	895.1	895.1	895.2	895.2	895.2	895.2	895.2	895.2
895.2	895.2	895.2	895.2	895.2	895.3	895.3	895.4	895.4	895.5
895.5	895.6	895.7	895.7	895.8	895.9	895.9	896.0	896.0	896.1
896.1	896.2	896.2	896.3	896.3	896.3	896.4	896.4	896.4	896.5
896.5	896.5	896.5	896.6	896.6	896.6	896.6	896.7	896.7	896.7
896.7	896.7	896.8	896.8	896.8	896.8	896.8	896.9	896.9	896.9
896.9	896.9	897.0	897.0	897.0	897.0	897.0	897.0	897.0	897.1
897.1	897.1	897.1	897.1	897.1	897.1	897.1	897.1	897.1	897.1
897.1	897.1	897.1	897.1	897.1	897.1	897.2	897.3	897.4	897.5
897.7	897.9	898.0	898.1	898.2	898.3	898.3	898.4	898.4	898.5
898.5	898.6	898.6	898.7	898.7	898.7	898.7	898.8	898.8	898.8
898.8	898.8	898.9	898.9	899.0	899.0	899.0	899.0	899.1	899.1
899.1	899.1	899.1	899.1	899.1	899.2	899.4	899.8	900.3	900.7
900.9	900.9	900.8	900.6	900.4	900.2	900.0	899.8	899.6	899.5
899.4	899.3	899.2	899.2	899.1	899.1	899.1	899.0	899.0	899.0
898.9	898.9	898.8	898.8	898.8	898.8	898.8	898.7	898.7	898.6
898.4	898.3	898.1	898.0	897.8	897.7	897.5	897.4	897.3	897.2
897.1	897.0	896.9	896.9	896.8	896.7	896.6	896.6	896.5	896.5
896.4	896.4	896.3	896.3	896.2	896.2	896.2	896.2	896.1	896.1
896.1	896.1	896.1	896.0	896.0	896.0	896.0	896.0	896.0	896.0
896.0	896.0	895.9	895.9	895.9	895.9	895.9	895.9	895.9	895.9
895.9	895.9	895.9	895.9	895.9	895.9	895.9	895.9	895.9	895.9
895.9	895.9	895.9	895.9	895.9	895.9	895.9	895.9		

PEAK OUTFLOW IS 2282. AT TIME 16.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2282.	722.	222.	222.	63865.
CMS	65.	20.	6.	6.	1808.
INCHES		11.82	14.53	14.53	14.53
MM		300.16	368.98	368.98	368.98
AC-FT		358.	440.	440.	440.
THOUS CU M		441.	543.	543.	543.

PLATE D-14

DIAGNOSTICS

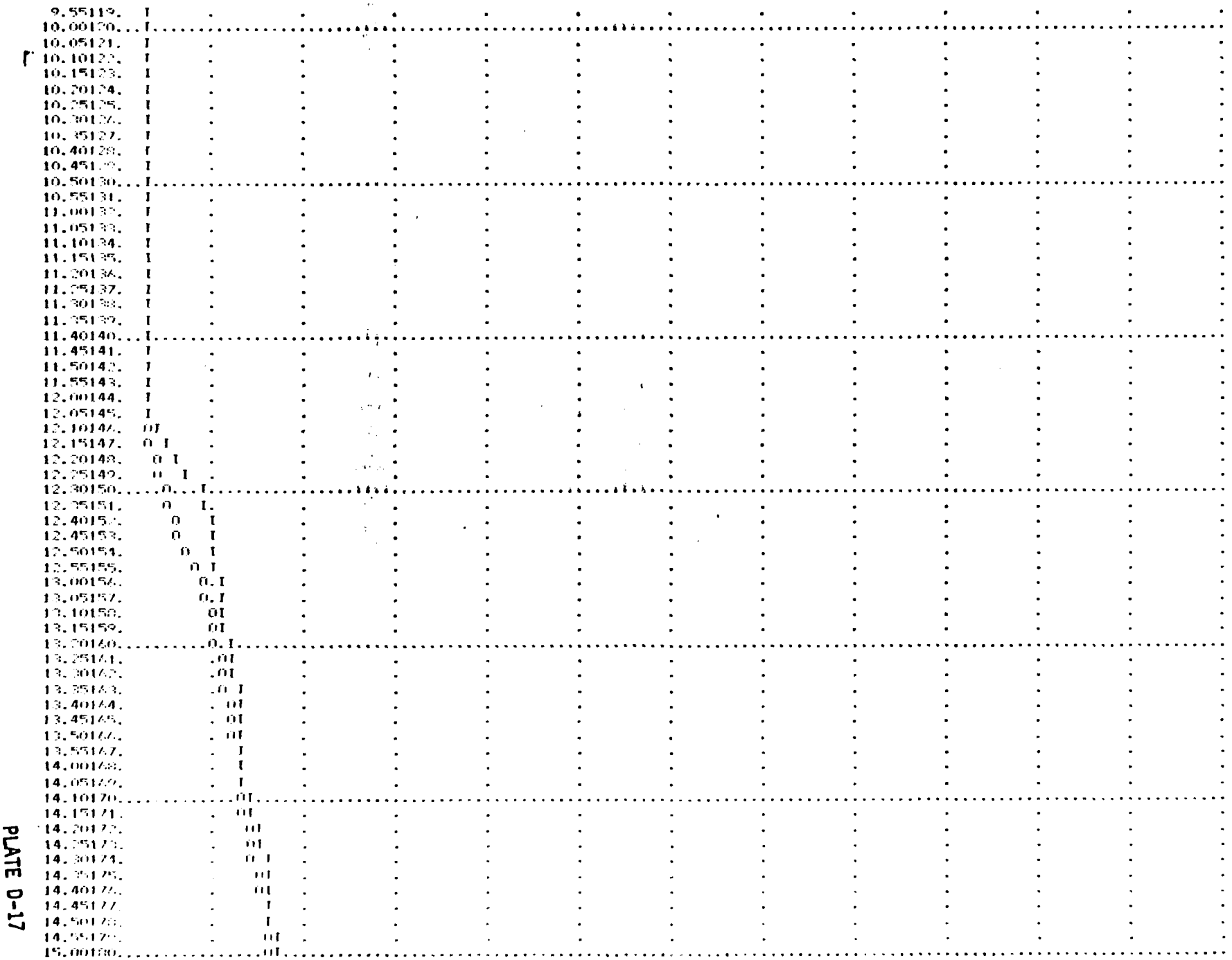
STATION000002

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

	0.	400.	800.	1200.	1600.	2000.	2400.	2800.	0.	0.	0.	0.	0.
.05	1I	.	.	.	.	.	.	.	.	.	.	.	.
.10	2I	.	.	.	.	.	.	.	.	.	.	.	.
.15	3I	.	.	.	.	.	.	.	.	.	.	.	.
.20	4I	.	.	.	.	.	.	.	.	.	.	.	.
.25	5I	.	.	.	.	.	.	.	.	.	.	.	.
.30	6I	.	.	.	.	.	.	.	.	.	.	.	.
.35	7I	.	.	.	.	.	.	.	.	.	.	.	.
.40	8I	.	.	.	.	.	.	.	.	.	.	.	.
.45	9I	.	.	.	.	.	.	.	.	.	.	.	.
.50	10I	.	.	.	.	.	.	.	.	.	.	.	.
.55	11I	.	.	.	.	.	.	.	.	.	.	.	.
1.00	12I	.	.	.	.	.	.	.	.	.	.	.	.
1.05	13I	.	.	.	.	.	.	.	.	.	.	.	.
1.10	14I	.	.	.	.	.	.	.	.	.	.	.	.
1.15	15I	.	.	.	.	.	.	.	.	.	.	.	.
1.20	16I	.	.	.	.	.	.	.	.	.	.	.	.
1.25	17I	.	.	.	.	.	.	.	.	.	.	.	.
1.30	18I	.	.	.	.	.	.	.	.	.	.	.	.
1.35	19I	.	.	.	.	.	.	.	.	.	.	.	.
1.40	20I	.	.	.	.	.	.	.	.	.	.	.	.
1.45	21I	.	.	.	.	.	.	.	.	.	.	.	.
1.50	22I	.	.	.	.	.	.	.	.	.	.	.	.
1.55	23I	.	.	.	.	.	.	.	.	.	.	.	.
2.00	24I	.	.	.	.	.	.	.	.	.	.	.	.
2.05	25I	.	.	.	.	.	.	.	.	.	.	.	.
2.10	26I	.	.	.	.	.	.	.	.	.	.	.	.
2.15	27I	.	.	.	.	.	.	.	.	.	.	.	.
2.20	28I	.	.	.	.	.	.	.	.	.	.	.	.
2.25	29I	.	.	.	.	.	.	.	.	.	.	.	.
2.30	30I	.	.	.	.	.	.	.	.	.	.	.	.
2.35	31I	.	.	.	.	.	.	.	.	.	.	.	.
2.40	32I	.	.	.	.	.	.	.	.	.	.	.	.
2.45	33I	.	.	.	.	.	.	.	.	.	.	.	.
2.50	34I	.	.	.	.	.	.	.	.	.	.	.	.
2.55	35I	.	.	.	.	.	.	.	.	.	.	.	.
3.00	36I	.	.	.	.	.	.	.	.	.	.	.	.
3.05	37I	.	.	.	.	.	.	.	.	.	.	.	.
3.10	38I	.	.	.	.	.	.	.	.	.	.	.	.
3.15	39I	.	.	.	.	.	.	.	.	.	.	.	.
3.20	40I	.	.	.	.	.	.	.	.	.	.	.	.
3.25	41I	.	.	.	.	.	.	.	.	.	.	.	.
3.30	42I	.	.	.	.	.	.	.	.	.	.	.	.
3.35	43I	.	.	.	.	.	.	.	.	.	.	.	.
3.40	44I	.	.	.	.	.	.	.	.	.	.	.	.
3.45	45I	.	.	.	.	.	.	.	.	.	.	.	.
3.50	46I	.	.	.	.	.	.	.	.	.	.	.	.
3.55	47I	.	.	.	.	.	.	.	.	.	.	.	.
4.00	48I	.	.	.	.	.	.	.	.	.	.	.	.
4.05	49I	.	.	.	.	.	.	.	.	.	.	.	.
4.10	50I	.	.	.	.	.	.	.	.	.	.	.	.
4.15	51I	.	.	.	.	.	.	.	.	.	.	.	.
4.20	52I	.	.	.	.	.	.	.	.	.	.	.	.
4.25	53I	.	.	.	.	.	.	.	.	.	.	.	.
4.30	54I	.	.	.	.	.	.	.	.	.	.	.	.
4.35	55I	.	.	.	.	.	.	.	.	.	.	.	.
4.40	56I	.	.	.	.	.	.	.	.	.	.	.	.

PLATE D-15

PLATE D-16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10.00120. I
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10.15123. I
10.20124. I
10.25125. I
10.30126. I
10.35127. I
10.40128. I
10.45129. I
10.50130. I
10.55131. I
11.00132. I
11.05133. I
11.10134. I
11.15135. I
11.20136. I
11.25137. I
11.30138. I
11.35139. I
11.40140. I
11.45141. I
11.50142. I
11.55143. I
12.00144. I
12.05145. I
12.10146. OI
12.15147. O I
12.20148. O I
12.25149. O I
12.30150. O. I
12.35151. O I.
12.40152. O I
12.45153. O I
12.50154. O I
12.55155. O I
13.00156. O.I
13.05157. O.I
13.10158. OI
13.15159. OI
13.20160. O.I
13.25161. .OI
13.30162. .OI
13.35163. .O I
13.40164. . OI
13.45165. . OI
13.50166. . OI
13.55167. . I
14.00168. . I
14.05169. . I
14.10170. .OI
14.15171. . OI
14.20172. . OI
14.25173. . OI
14.30174. . O I
14.35175. . OI
14.40176. . OI
14.45177 . I
14.50178. . I
14.55179. . OI
15.00180. .OI

PLATE D-17

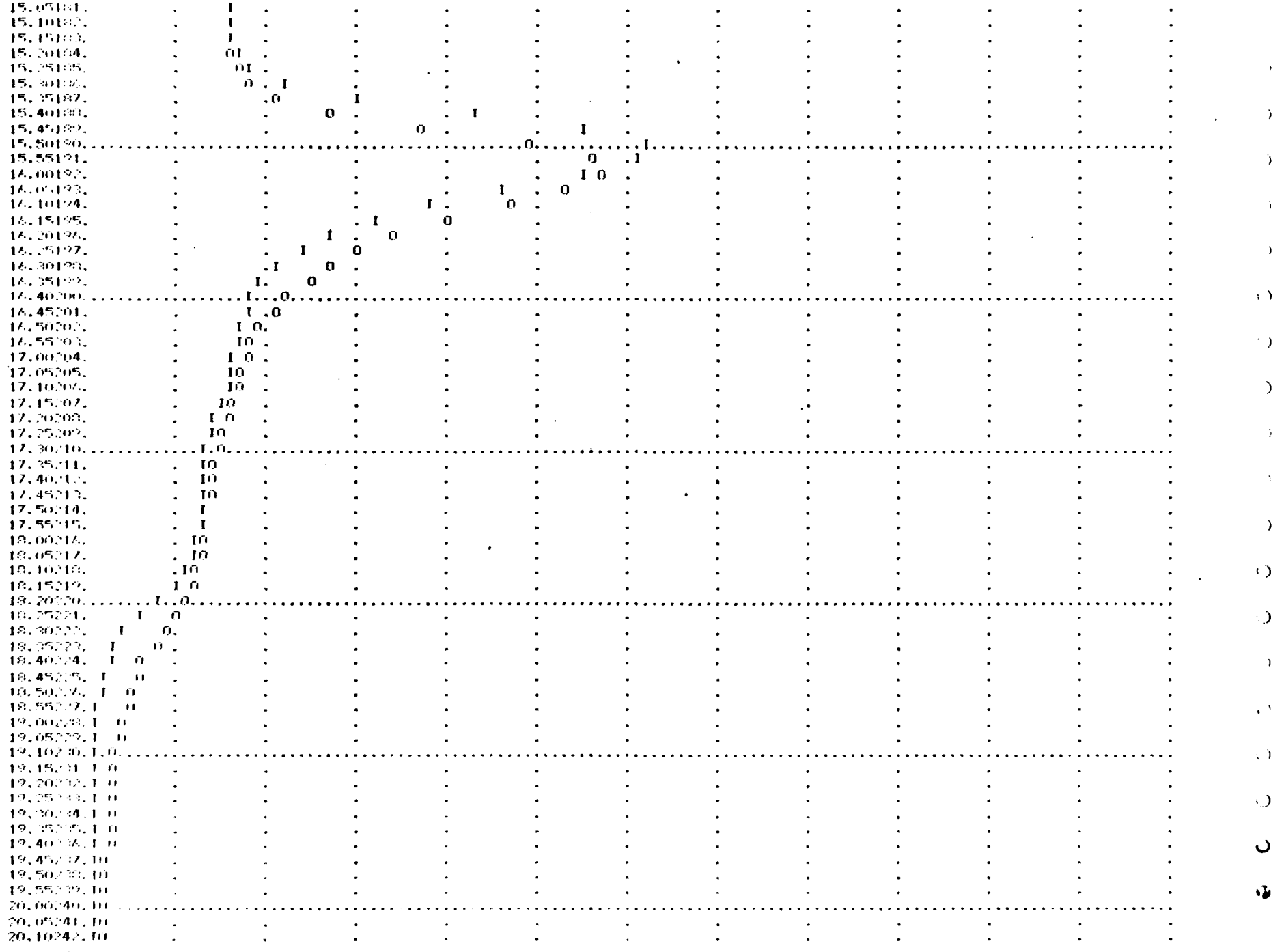

PLATE D-18

PLATE D-19

KOVN

STATION 000002, PLAN 1, RATIO 8 PMF

END OF PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	1.	1.	1.	1.	2.	2.	2.	2.
3.	3.	3.	3.	4.	4.	4.	4.	5.	6.
6.	7.	7.	8.	8.	9.	9.	10.	10.	11.
11.	12.	12.	13.	14.	17.	21.	27.	33.	40.
47.	56.	65.	74.	82.	90.	97.	100.	103.	107.
110.	123.	134.	144.	153.	161.	168.	174.	180.	185.
190.	194.	198.	202.	205.	208.	211.	214.	217.	219.
221.	223.	225.	227.	229.	231.	232.	234.	235.	237.
238.	239.	240.	241.	243.	244.	245.	245.	246.	247.
248.	249.	250.	250.	251.	252.	253.	253.	254.	254.
255.	256.	256.	257.	258.	268.	292.	333.	388.	451.
520.	590.	658.	715.	757.	787.	811.	831.	852.	877.
905.	934.	960.	982.	1000.	1015.	1026.	1035.	1043.	1053.
1071.	1099.	1133.	1171.	1206.	1251.	1279.	1298.	1310.	1319.
1322.	1316.	1305.	1309.	1356.	1495.	1827.	2492.	3644.	4500.
4854.	4623.	4119.	3494.	2937.	2485.	2194.	1959.	1767.	1622.
1517.	1440.	1386.	1348.	1320.	1292.	1258.	1216.	1181.	1147.
1114.	1085.	1062.	1044.	1030.	1020.	1008.	985.	933.	847.
737.	615.	522.	444.	379.	321.	270.	243.	224.	206.
190.	175.	162.	150.	140.	131.	123.	117.	111.	109.
108.	107.	106.	105.	104.	103.	102.	101.	100.	99.
99.	98.	97.	96.	95.	94.	93.	91.	90.	89.
88.	88.	87.	86.	86.	85.	85.	84.	84.	83.
83.	83.	82.	82.	82.	82.	81.	81.	81.	81.
81.	81.	81.	81.	80.	80.	80.	80.		

STORAGE

39.	39.	39.	39.	39.	39.	39.	39.	39.	39.
39.	39.	39.	39.	39.	39.	39.	39.	39.	39.
39.	39.	39.	39.	39.	39.	39.	39.	39.	39.
39.	39.	39.	39.	39.	39.	39.	39.	39.	39.
39.	39.	40.	40.	40.	40.	40.	40.	40.	40.
40.	40.	40.	40.	40.	40.	40.	40.	40.	40.
40.	41.	41.	41.	41.	41.	41.	41.	41.	41.
41.	41.	41.	41.	41.	42.	42.	43.	43.	44.
44.	45.	45.	46.	47.	47.	48.	48.	49.	49.
50.	51.	51.	51.	52.	52.	52.	53.	53.	53.
53.	54.	54.	54.	54.	54.	54.	55.	55.	55.
55.	55.	55.	55.	55.	55.	55.	56.	56.	56.
56.	56.	56.	56.	56.	56.	56.	56.	56.	56.
56.	56.	56.	56.	56.	56.	56.	56.	56.	56.
57.	57.	57.	57.	57.	57.	57.	58.	60.	61.
63.	64.	65.	66.	67.	67.	68.	68.	68.	69.
69.	70.	70.	70.	71.	71.	71.	71.	71.	71.
72.	72.	73.	73.	74.	74.	74.	74.	75.	75.
75.	75.	75.	75.	75.	76.	79.	84.	90.	94.
94.	95.	93.	90.	87.	84.	82.	80.	79.	77.
76.	76.	75.	75.	75.	74.	74.	74.	73.	73.
72.	72.	71.	71.	71.	71.	71.	70.	70.	68.
66.	65.	63.	61.	59.	58.	57.	56.	55.	54.
53.	53.	52.	52.	51.	51.	51.	50.	50.	50.

PLATE D-20

50.	49.	49.	49.	49.	49.	49.	48.	48.	48.
48.	48.	48.	48.	48.	47.	47.	47.	47.	47.
47.	47.	47.	47.	47.	47.	47.	47.	47.	47.
47.	47.	47.	47.	47.	47.	47.	47.	47.	47.
47.	47.	47.	47.	47.	47.	47.	47.		

STAGE

895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0
895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0
895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0
895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0	895.0
895.0	895.0	895.0	895.0	895.1	895.1	895.1	895.1	895.1	895.1
895.1	895.1	895.1	895.2	895.2	895.2	895.2	895.2	895.2	895.2
895.2	895.3	895.3	895.3	895.3	895.3	895.3	895.3	895.3	895.4
895.4	895.4	895.4	895.4	895.4	895.5	895.6	895.7	895.8	895.9
896.0	896.1	896.2	896.3	896.4	896.5	896.6	896.7	896.8	896.9
897.0	897.1	897.2	897.2	897.3	897.3	897.4	897.4	897.5	897.5
897.5	897.6	897.6	897.6	897.6	897.7	897.7	897.7	897.7	897.7
897.8	897.8	897.8	897.8	897.8	897.8	897.8	897.8	897.8	897.9
897.9	897.9	897.9	897.9	897.9	897.9	897.9	897.9	897.9	897.9
897.9	897.9	897.9	897.9	898.0	898.0	898.0	898.0	898.0	898.0
898.0	898.0	898.0	898.0	898.0	898.0	898.1	898.2	898.4	898.6
898.8	899.0	899.1	899.2	899.3	899.3	899.4	899.4	899.4	899.5
899.5	899.6	899.6	899.6	899.7	899.7	899.7	899.7	899.7	899.8
899.8	899.8	899.9	899.9	900.0	900.0	900.1	900.1	900.1	900.1
900.1	900.1	900.1	900.1	900.1	900.3	900.6	901.0	901.6	901.9
902.1	902.0	901.8	901.5	901.3	901.0	900.8	900.7	900.5	900.4
900.3	900.2	900.2	900.1	900.1	900.1	900.0	900.0	900.0	899.9
899.9	899.8	899.8	899.7	899.7	899.7	899.7	899.6	899.6	899.4
899.2	899.0	898.8	898.6	898.4	898.2	898.0	897.9	897.8	897.6
897.5	897.4	897.3	897.3	897.2	897.1	897.1	897.0	897.0	897.0
896.9	896.9	896.9	896.8	896.8	896.8	896.8	896.7	896.7	896.7
896.7	896.7	896.6	896.6	896.6	896.6	896.6	896.5	896.5	896.5
896.5	896.5	896.5	896.5	896.5	896.5	896.5	896.5	896.4	896.4
896.4	896.4	896.4	896.4	896.4	896.4	896.4	896.4	896.4	896.4
896.4	896.4	896.4	896.4	896.4	896.4	896.4	896.4		

PEAK OUTFLOW IS 4854. AT TIME 15.92 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4854.	1454.	444.	444.	127963.
CMS	137.	41.	13.	13.	3624.
INCHES		23.81	29.11	29.11	29.11
MM		604.87	739.31	739.31	739.31
AC-FT		721.	881.	881.	881.
THOUS CU M		889.	1087.	1087.	1087.

OVF

STATION000002

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

	0.	1000.	2000.	3000.	4000.	5000.	0.	0.	0.	0.	0.	0.	0.
.05	1I	.	.	.	.	.	.	.	.	.	.	.	.
.10	2I	.	.	.	.	.	.	.	.	.	.	.	.
.15	3I	.	.	.	.	.	.	.	.	.	.	.	.
.20	4I	.	.	.	.	.	.	.	.	.	.	.	.
.25	5I	.	.	.	.	.	.	.	.	.	.	.	.
.30	6I	.	.	.	.	.	.	.	.	.	.	.	.
.35	7I	.	.	.	.	.	.	.	.	.	.	.	.
.40	8I	.	.	.	.	.	.	.	.	.	.	.	.
.45	9I	.	.	.	.	.	.	.	.	.	.	.	.
.50	10I	.	.	.	.	.	.	.	.	.	.	.	.
.55	11I	.	.	.	.	.	.	.	.	.	.	.	.
1.00	12I	.	.	.	.	.	.	.	.	.	.	.	.
1.05	13I	.	.	.	.	.	.	.	.	.	.	.	.
1.10	14I	.	.	.	.	.	.	.	.	.	.	.	.
1.15	15I	.	.	.	.	.	.	.	.	.	.	.	.
1.20	16I	.	.	.	.	.	.	.	.	.	.	.	.
1.25	17I	.	.	.	.	.	.	.	.	.	.	.	.
1.30	18I	.	.	.	.	.	.	.	.	.	.	.	.
1.35	19I	.	.	.	.	.	.	.	.	.	.	.	.
1.40	20I	.	.	.	.	.	.	.	.	.	.	.	.
1.45	21I	.	.	.	.	.	.	.	.	.	.	.	.
1.50	22I	.	.	.	.	.	.	.	.	.	.	.	.
1.55	23I	.	.	.	.	.	.	.	.	.	.	.	.
2.00	24I	.	.	.	.	.	.	.	.	.	.	.	.
2.05	25I	.	.	.	.	.	.	.	.	.	.	.	.
2.10	26I	.	.	.	.	.	.	.	.	.	.	.	.
2.15	27I	.	.	.	.	.	.	.	.	.	.	.	.
2.20	28I	.	.	.	.	.	.	.	.	.	.	.	.
2.25	29I	.	.	.	.	.	.	.	.	.	.	.	.
2.30	30I	.	.	.	.	.	.	.	.	.	.	.	.
2.35	31I	.	.	.	.	.	.	.	.	.	.	.	.
2.40	32I	.	.	.	.	.	.	.	.	.	.	.	.
2.45	33I	.	.	.	.	.	.	.	.	.	.	.	.
2.50	34I	.	.	.	.	.	.	.	.	.	.	.	.
2.55	35I	.	.	.	.	.	.	.	.	.	.	.	.
3.00	36I	.	.	.	.	.	.	.	.	.	.	.	.
3.05	37I	.	.	.	.	.	.	.	.	.	.	.	.
3.10	38I	.	.	.	.	.	.	.	.	.	.	.	.
3.15	39I	.	.	.	.	.	.	.	.	.	.	.	.
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3.50	46I	.	.	.	.	.	.	.	.	.	.	.	.
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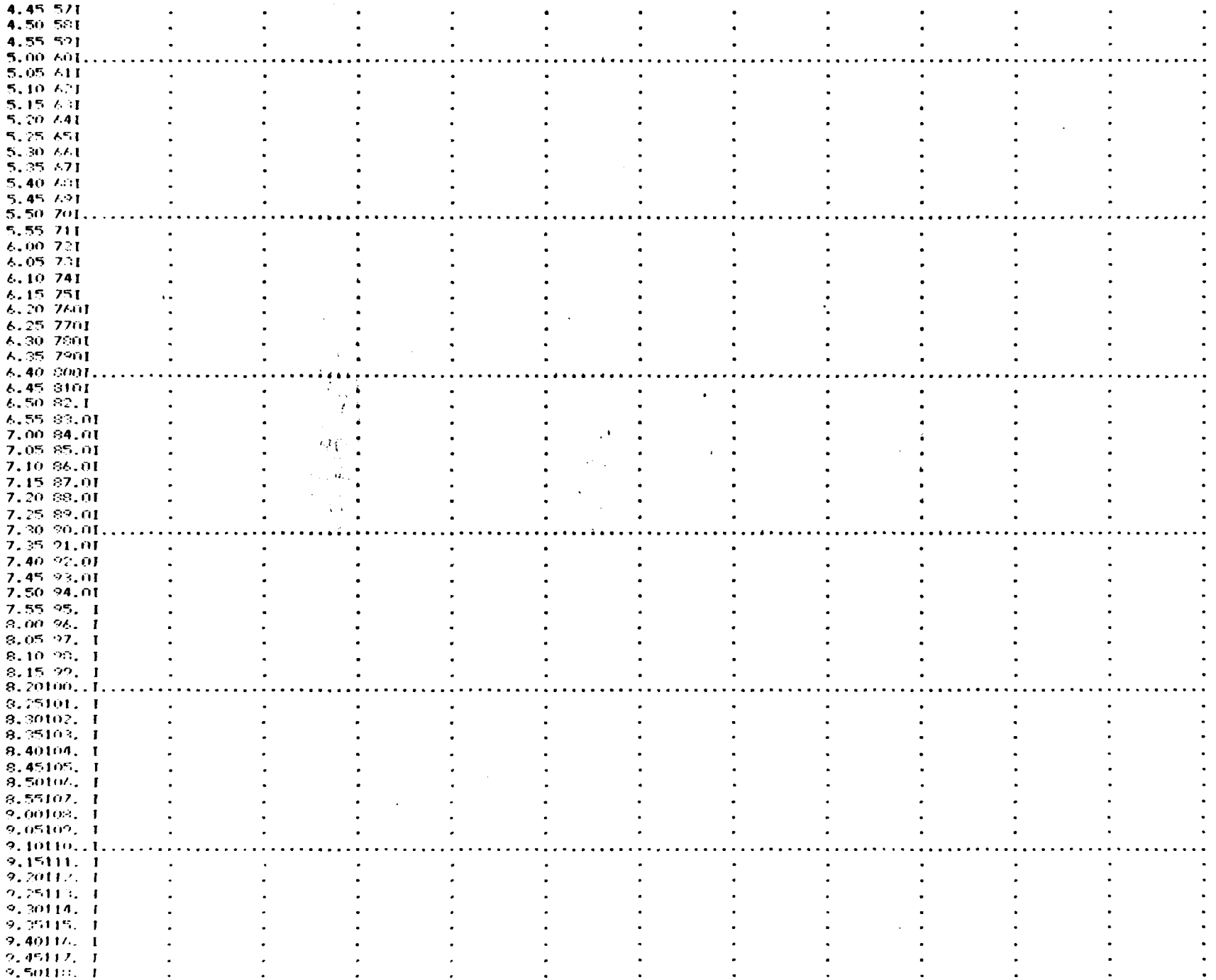
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PLATE D-23

PLATE D-24

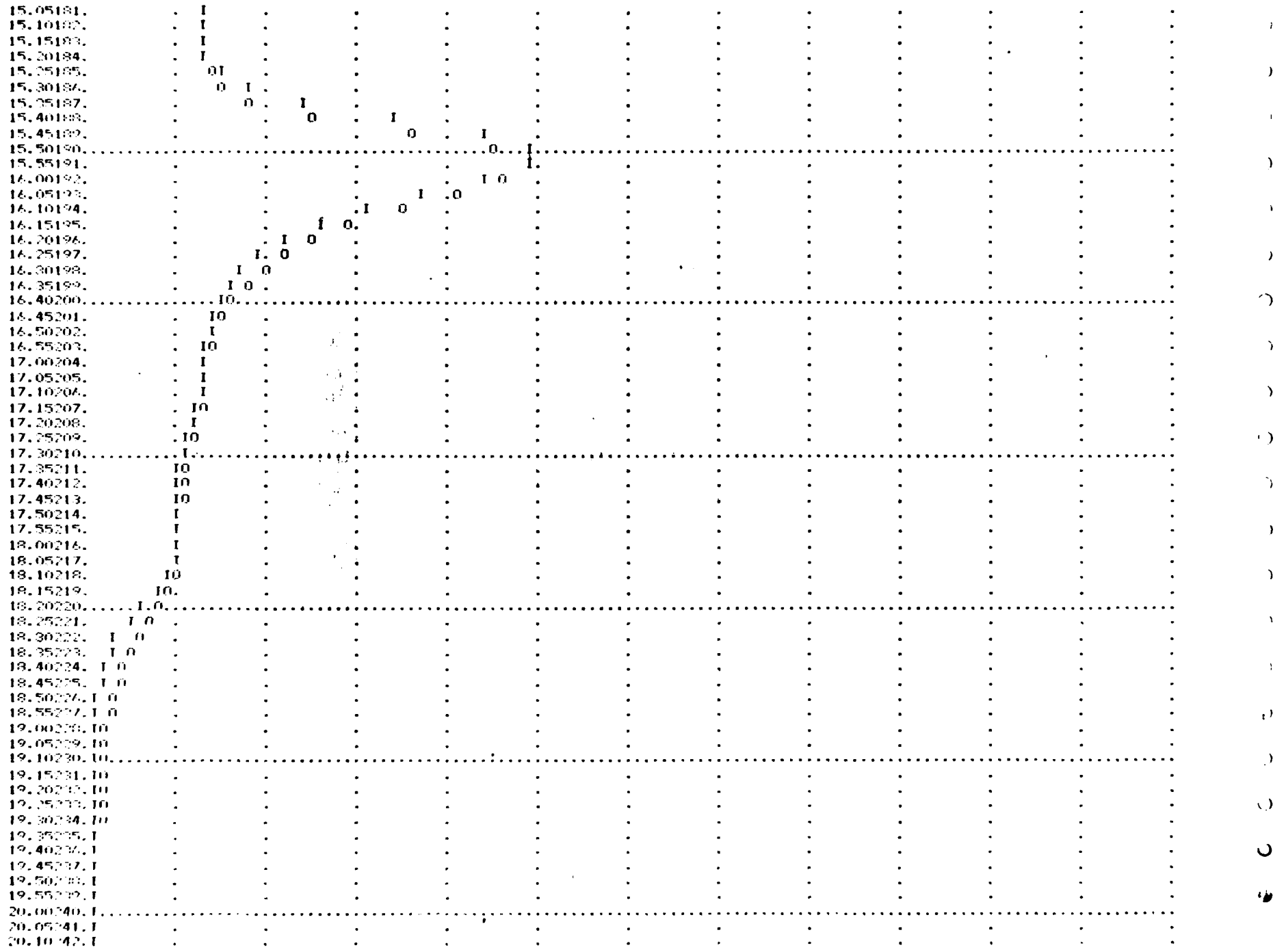
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PLATE D-25

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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1 .05	RATIO 2 .10	RATIO 3 .15	RATIO 4 .20	RATIO 5 .35	RATIO 6 .50	RATIO 7 .70	RATIO 8 1.00
HYDROGRAPH AT	000001	.57	1	246.	493.	739.	985.	1724.	2463.	3448.	4925.
		(1.47)		(6.97)(	13.95)(	20.92)(	27.89)(	48.82)(	69.74)(	97.63)(	139.47)(
ROUTED TO	000002	.57	1	127.	339.	568.	810.	1557.	2282.	3348.	4854.
		(1.47)		(3.59)(	9.59)(	16.09)(	22.95)(	44.08)(	64.62)(	94.81)(	137.44)(

PLATE D-27

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	895.00	895.00	898.70
STORAGE	39.	39.	62.
OUTFLOW	0.	0.	484.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.05	897.11	0.00	51.	127.	0.00	16.25	0.00
.10	898.25	0.00	59.	339.	0.00	16.08	0.00
.15	898.90	.20	64.	568.	.42	16.08	0.00
.20	899.36	.66	68.	810.	.75	16.00	0.00
.35	900.32	1.62	77.	1557.	1.67	16.00	0.00
.50	900.91	2.21	83.	2282.	4.42	16.00	0.00
.70	901.45	2.75	89.	3348.	5.58	15.92	0.00
1.00	902.07	3.37	96.	4854.	6.08	15.92	0.00

PLATE D-28